KSV 6HE

Servo Amplifier for Brushless Motors

KSV 1,5/5 to KSV 12/30

19 inch, 6 height units, front connection

Operating Instructions 221052E, V 1.3b 09/01

These operating instructions apply to

- KSV 6HE KSV 1,5/5 to KSV 12/30 servo amplifiers (19" plug-in module) (even numbers)
- 2800140000 power supply (19" plug-in module)
- 038100050Z, 038100070Z, 038100090Z and 038100130Z mains transformers
- accessories

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Versions of the document

30.11.99	V 1.3, MH	First English version, based on 221059 V 1.3 and 221055E V 1.5a; similar to German version 1.3
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These operating instructions have been prepared with care. However, GEORGII KOBOLD AUGUST HEINE GmbH & Co can accept no liability for any errors in these operating instructions or possible consequences. Neither can any liability be accepted for direct or indirect damage resulting from abuse of the device.

The relevant regulations concerning safety technology and electromagnetic compatibility must be complied with when using the device.

Subject to alteration.

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Chapter 4: Notes for specialists

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Chapter 1: General information

1 Preliminary remarks

1.1 About this description

These operating instructions explain the characteristics, connection, installation and setting up of

- the KSV 6HE servo amplifiers, designed as 19" plug-in modules (6 units height),
- the associated power supplies, 19" plug-in module design (6 units height), for the connection to 3 × 230 V three-phase current,
- the mains transformers for the connection to 3 × 400 V three-phase current and the RFI-filter,
- accessories,
- and provides notes for specialists.

The operation instructions are divided up into 4 chapters and 12 sections. After the safety instructions and the technical specifications, the connection of the servo amplifier is described. In some cases you will require details which are not explained more fully until later. It is therefore important that you should read the sections important for your application in a sequence commensurate with your previous knowledge.

The chapter “Notes for the specialist” describes changes which can be carried out on site by specially qualified electronics experts at their own risk, providing that all precautions have been taken.

1.2 KSV 6HE Servo Drive Packages

KSV 6HE servo drive packages in 19" design consist of:

- the brushless motor with coupled resolver as a speed and position sensor,
- the analog servo amplifier as 19" plug-in module (6 units height),
- the 19" plug-in module power supply (6 units height) with mains transformer connected in series.

The series described here comprises

- amplifiers for 5 different currents (1.5 A_{rms} to 12 A_{rms}),
- amplifiers with different specifications (optional),

- power supplies for 19" rack system (“plug-in power supplies”),
- mains transformers for the plug-in power supplies,
- RFI-filters,
- 19" chassis.

We construct the multi-axis servo amplifier matched to your application using chassis. Use these operating instructions for connecting and commissioning.

We evaluate the servo drive matched to your application and

- deliver the matching servo motor.
  - They have separate operating instructions and terminal connection diagrams.

As well as the series in 19" plug-in module design, there is also a series in compact design for installation on the mounting plate of a control cabinet (KSV 1,5/5 compact design to KSV 12/30 compact design amplifiers) with separate operating instructions.

2 Safety instructions

2.1 Type of instruction

It is essential that you should note the warnings and instructions in the margin:

Danger

- Danger for life and limb through electrical shock or motion of the drive system.

Caution

- Caution. Disregard can lead to personal injury or death or damage of property.

Do not

- Prohibition. Disregard is a violation of safety regulations or statutory provisions.

Power off
wait > 2 min

- Power off. Disconnect the device from the mains and wait at least 2 minutes until the DC-bus capacitors have discharged before carrying out the measures described.

CE/EMC

- The CE marking presumes compliance with the EMC limits in accordance with EN 55011, A and B (emissions) and EN 50082 1 and 2 (immunity). The specifications marked with this symbol must be complied with. Otherwise the installation in which the amplifier is being run must be checked for compliance with the EMC limits at the discretion of the customer.

Other instructions given in the margin:

Check

- Check. First check these positions if the drive system does not work as required or if you cannot proceed working with the device for other reasons.

Tip

- Tip. Useful hint.

2.2 Technical staff

Danger

The servo amplifiers and the power supplies work with voltages which are dangerous in case of contact. Touching live parts can cause serious injury or death.

Only trained technical staff with special knowledge in the fields of

- automation,
- dealing with dangerous voltages,

CE/EMC

- standards and regulations such as
  - EMC directive (89/336 EEC),
  - low voltage directive (73/23 EEC),
  - machinery directive (89/392 EEC),

– VDE regulations (such as DIN VDE 0100, DIN VDE 0113 <EN 60204>, DIN VDE 0160 <EN 50178>),

– safety rules

may therefore

- install,
- commission,
- maintain and
- service

these units.

They must read these operating instructions carefully beforehand, and always follow the safety instructions while working.

2.3 Use for the intended purpose

The servo amplifiers and the power supplies have been developed, manufactured, tested and documented in accordance with the relevant standards. If used for the intended purpose, the devices do not cause any danger to persons or property. Use for the intended purpose requires that the device should be used only in the manner described here and that the safety regulations mentioned are adhered to.

Caution

When using the devices, use for the intended purpose includes compliance with the relevant regulations with respect to safety (machinery directive) and electromagnetic compatibility (EMC directive).

Dispose of the apparatus at the end of its useful service life in accordance with the current regulations.

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2.4 Protective earthing

On account of leakage current from the RFI-filter to be built-in, the protective earth conductor, in accordance with DIN VDE 0160, must

- either be run double to the amplifier or
- have a cable cross-section of at least 10 mm^2 Cu.

Operation using an earth-leakage circuit breaker is not possible

- due to the leakage current of the RFI-filter and

- since in case of earth leakage a part of the direct current flows in the protective earth conductor.

2.5 Hazard warnings

Caution

Due to their design and connection system, the servo amplifiers and the power supplies

- may only be operated in closed housings (control cabinet);
- may only be operated with a fixed connection to the mains.

Do not introduce any objects (screwdrivers, wires) into the interior of the device through the ventilation holes.

Before you remove a device from the chassis and before you disconnect or reconnect a connector

Power off
wait > 2 min

- switch off mains voltage.

The charging capacitor of the power supply retains the voltage even after it has been switched off. Before working at or in the device

- wait at least two minutes after switching off.

Danger

Electronic devices are generally not fail-safe. The user must make sure

- that when a device breaks down
  - the drive is switched to a safe state.

2.6 CE marking

The KSV 6HE servo amplifiers meet the requirements of

- the EMC directive (89/336 EEC) and
- the low voltage directive (73/23 EEC).

CE

They thus conform to the currently valid EU regulations and bear the CE marking.

CE/EMC

The CE marking only applies

- when all installation and connection requirements of these operating instructions have been exactly complied with, and
- when the requirements in the notes next to the CE/EMC marks have been met.

If this is not possible, then

- you must have the installation in which the amplifiers are being operated tested at your own discretion for compliance with the EMC limits.

2.7 Preconditions for commissioning

In addition to the low voltage and EMC directives applicable to the servo amplifiers, the

- machinery directive (89/392 EEC) applies to machines.

The machinery directive (89/392 EEC) applies to the final product, that is, the machine containing the servo amplifier. The machine manufacturer must comply with the machinery directive (89/392 EEC).

Do not

Commissioning is forbidden until the requirements of the machinery directive have been met.

2.8 Working with the amplifier or the power supply

To replace modules or to carry out matching or other work,

- first disconnect the device from the mains,
- pull off the connector and remove cables from the terminals, and
- remove the device from the chassis after loosening the front panel screws.

Danger

Never operate the device when it is removed from hte chassis!

Chapter 2: Servo amplifier

3 Technical specifications

3.1 Type code

The type code clearly identifies a servo amplifier equipped in a certain way. The type code also applies for devices of the series in compact design.

Example ⇨ KSV * 3/10-N0-K4-Z0-P2-G1-F0-E1-S0-W0

⇩

*****

Design *
(no text) = 19" plug-in module
"compact design" = compact device

3/10

Power
1.5/5 320 V DC-bus, output 1.5 A_{rms} rated current, 5 A peak current
3/10 320 V DC-bus, output 3 A_{rms} rated current, 10 A peak current
6/20 320 V DC-bus, output 6 A_{rms} rated current, 20 A peak current
9/30 320 V DC-bus, output 9 A_{rms} rated current, 30 A peak current
12/30 320 V DC-bus, output 12 A_{rms} rated current, 30 A peak current

N0

Power supply
N0 no power supply, external power supply KSN 8 M1 (280014000) needed (standard)
N2 power supply, 3-phase 3 × 230 V

K4

Controller switching (customer module and jumpers)
K0 none (device not ready for operation)
K1 2-pole-pair motor, speed control 3,500 min^{-1}
K2 2-pole-pair motor, speed control 7,000 min^{-1}
K3 2-pole-pair motor, current control
K4 3-pole-pair motor, speed control 3,500 min^{-1}

Z0

Additional equipment through add-on modules
Z0 none (standard)
Z1 limit switch, ramp, controller inhibit braking
Z2 external current limiting, rotation reversal

P2

Input/output polarity (polarity module)
P0 switching towards zero (standard)
P1 PLC-compatible, "fault" output

G1

Additional equipment through encoder modules
(incremental encoder emulation)
G0 no pulse outputs (standard)
G1 pulse outputs, 5 V push-pull signals RS 422
G2 pulse outputs, 24 V push-pull signals

F0

Additional equipment through function modules
F0 none (standard)
F1 holding control loop

E1

Supply of control circuit (cannot be refitted)
E0 internal supply from DC-bus (standard)

S0

Special equipment (customization)
S0 none (standard)
S2 reinforced terminals (20 A)

W0

Front panel
W0 standard

For further details on the modular expansion options, please refer to section 6, page 50.

3.2 Technical specifications

Servo amplifier		KSV 1,5/5	KSV 3/10	KSV 6/20	KSV 9/30	KSV 12/30
Mains connection via isolat. transformer		3 × 120 .. 230 V AC, (+10%)				
Bus voltage		320 V DC				
Minimum bus voltage		160 V DC				
Maximum permissible bus voltage		420 V DC				
Maximum continuous current (rms value)		1.5 A	3 A	6 A	9 A	12 A
Maximum peak current (crest value)		5 A	10 A	20 A	30 A	30 A
Current limiting adjustable from... to...		0.4..1.5 A	0.8..3 A	1.5..6 A	2.3..9 A	3..12 A
Load factor (in conjunction with mains transformer) [1]		4	8	16	24	32
Integration time of the I²t circuit at max. peak current		approx. 2 s				
Setpoint value		±10 V at 20 kΩ				
Operating range of speed trimmer		1 : 7				
Output speed monitor (R_A = 10 kΩ) at speed range	±3500 r.p.m.	2 V /1000 r.p.m.				
	±7000 r.p.m.	1 V /1000 r.p.m.				
	±10,500 r.p.m.	0.67 V /1000 r.p.m.				
	±14,000 r.p.m.	0.5 V /1000 r.p.m.				
Output current monitor (RA = 10 kΩ)		±10 V for maximum pulse current				
Switching frequency		16 kHz				
Frequency of current ripple		32 kHz				
Auxiliary voltage outputs		+15 V and –15 V, ±10%				
Load capacity of auxiliary voltages		10 mA each (via 125 Ω PTC)				
For option E1: external control circuit supply		24 V DC, –15+20%, approx. 400 mA at 24 V				
Climatic category (DIN EN 50178) operation / storage / transport		3K3 / 1K4 / 2K3				
Permissible ambient temperature in continuous operation	without fan	50 °C	40 °C	not permissible		
	with fan [2]	55 °C	55 °C	50 °C	45 °C	40 °C
Wiring to Combicon connectors	Recommended cross-section	1.5 mm²	1.5 mm²	1.5 mm²	2.5 mm²	2.5 mm²
	Minimum cross-section	0.75 mm²	0.75 mm²	1.0 mm²	1.5 mm²	1.5 mm²

[1] The load factor given is for calculating the number of amplifiers that can be operated by one common power supply. For further details see Section 9.1, page 68.

[2] Fan of the 089100010Z or 089100020Z chassis, see section 10, page 75.

Servo amplifier	KSV 1,5/5	KSV 3/10	KSV 6/20	KSV 9/30	KSV 12/30
Width	10 units / 50.8 mm				
Height	6 height units / 262 mm				
Depth (without connectors)	195 mm				
Weight	1.3 kg				

3.3 Details

3.3.1 Design

KSV 6HE servo amplifiers in 19“ design are manufactured as plug-in modules. They consist of a printed circuit assembly (PCA) with heat sink arranged in parallel, the customer module and the front panel. The PCA has slots for the modules (explained later).

All connections, trim potentiometers, and LEDs are located at the front panel:

- control signals: 15-pin SUB-D female connector,
- motor and operating voltage input: 7-pin Combicon connector,
- position sensor (resolver): 9-pin SUB-D female connector,
- output for encoder signals: 15-pin SUB-D male connector
  - present only if encoder module is mounted.

The devices for continuous currents up to 3 A

- work with natural convection.

The devices for continuous currents above 3 A

- need fans like the ones included in our chassis 089100010Z and

For currents and temperatures, see table “Technical specifications”, page 16, for chassis, see section 10, page 75.

3.3.2 Chassis

Use chassis to combine multiple KSV 6HE amplifier plug-in modules with the power supply (or several power supplies). For further details, refer to section 10.2.1, page 75.

CE/EMC

The requirements of the EMC directive are fulfilled,

- if the KSV 6HE servo amplifiers are built into an Georgii Kobold chassis, and

- if the installation follows the connection directions given on page 36ff.

The CE marking is valid only when the EMC limits are complied with.

If you install the amplifier in a different way,

- it is your responsibility to check the installation for complying with the EMC limits.

Caution

The air must be able to flow through the chassis undisturbed.

- If you install additional chassis above or below,
  - they must not obstruct the air flow.

Tip

Note that the air leaving the chassis is heated up,

- this may disturb devices sensitive to heat.

Figure 1 shows a rack mount chassis 84 units wide, fully equipped with one power supply and 7 amplifiers.

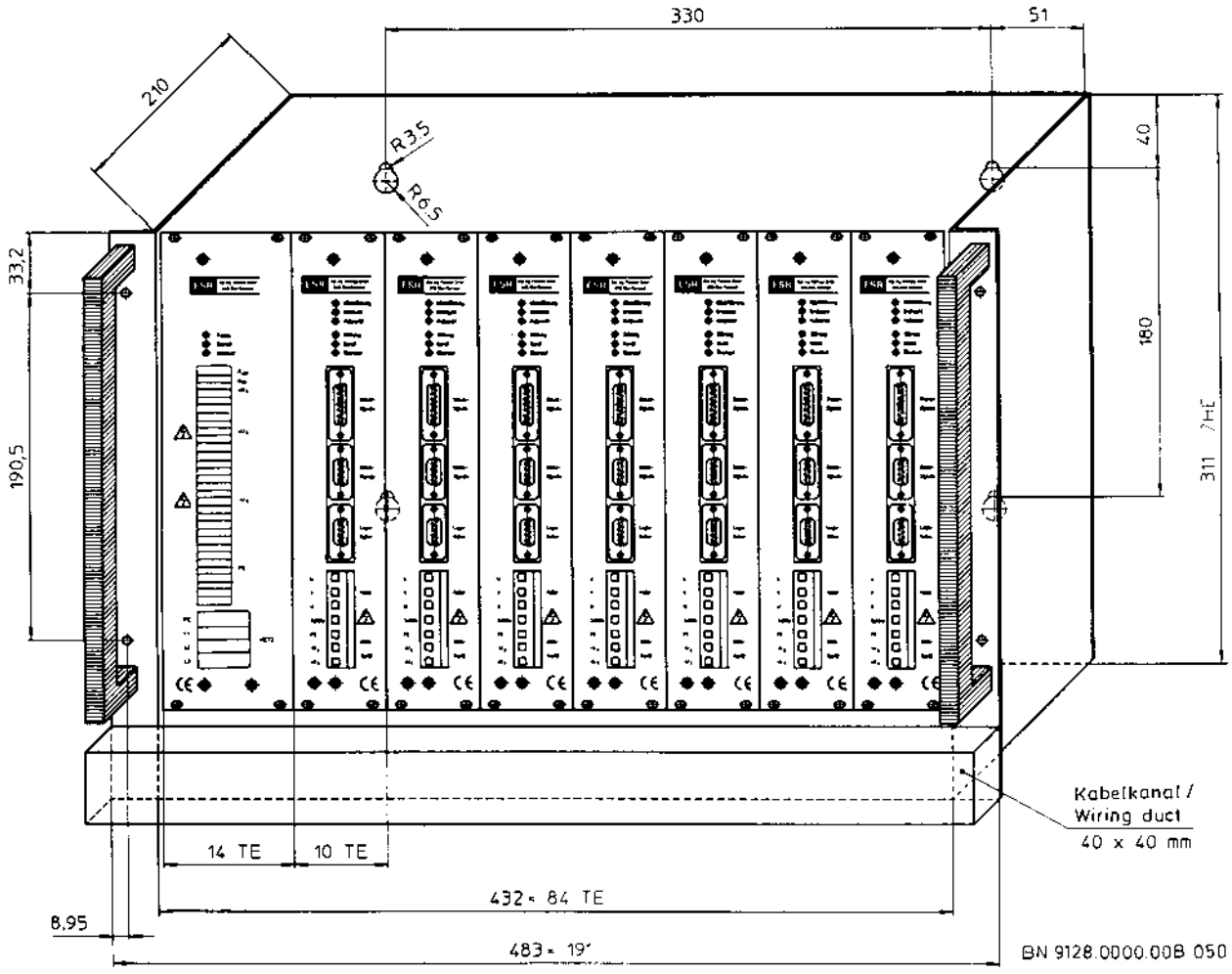


Fig. 1: Rack mount chassis 84 units wide

4 Connection: Assignment of connectors and details

4.1 Connector assignments

For details concerning connections and the optional modules, please refer to the later sections.

4.1.1 Motor and power supply (Combicon connector X1)

Marking	Assignment
Motor U	Motor connection U
Motor V	Motor connection V
Motor W	Motor connection W
PE	PE for motor cable
PE	PE from power supply
$-U_B$	Negative pole of bus voltage from power supply
$+U_B$	Positive pole of bus voltage from power supply

4.1.2 Control signals “Steuersignale” (SUB-D fem. connector X2, 15-pin)

4.1.2.1 Version without add-on module

Pin	Assignment
1	0 Volt
2	Output auxiliary voltage +15 V
3	Output auxiliary voltage –15 V
4	Input setpoint (E+)
5	Input setpoint (E–)
6	Switching input “Controller enable”
7	not assigned
8	not assigned
9	Switching input “Reset fault”
10	Input +24 V for modules P1, P2 and/or E1 (only if fitted)
11	not assigned
12	Switching output “Fault” (or “Ready”)
13	Analog output “Speed monitor”
14	Switching output “Overload”
15	Analog output “Current monitor”
Housing	Connect cable shield to the housing of the SUB-D connector

4.1.2.2 Version with Z1 add-on module

Pin	Assignment
1	0 Volt
2	Output auxiliary voltage +15 V
3	Output auxiliary voltage –15 V
4	Input setpoint (E+)
5	Input setpoint (E–)
6	Switching input “Controller enable”
7	Switching input “Limit switch 1”
8	Switching input “Limit switch 2”
9	Switching input “Reset fault”
10	Input +24 V for modules P1, P2 and/or E1 (only if fitted)
11	Switching output “Motor standstill” (or “Power circuit ready”)
12	Switching output “Fault” (or “Ready”)
13	Analog output “Speed monitor”
14	Switching output “Overload”
15	Analog output “Current monitor”
Housing	Connect cable shield to the housing of the SUB-D connector

4.1.2.3 Version with Z2 add-on module

Pin	Assignment
1	0 Volt
2	Output auxiliary voltage +15 V
3	Output auxiliary voltage –15 V
4	Input setpoint (E+)
5	Input setpoint (E–)
6	Switching input “Controller enable”
7	Switching input “Setpoint reversing”
8	Analog input “Current reduction”
9	Switching input “Reset fault”
10	Input +24 V for modules P1, P2 and/or E1 (only if fitted)
11	Switching output “Motor standstill” (or “Power circuit ready”)
12	Switching output “Fault” (or “Ready”)
13	Analog output “Speed monitor”
14	Switching output “Overload”
15	Analog output “Current monitor”
Housing	Connect cable shield to the housing of the SUB-D connector

4.1.2.4 Version with Z4 add-on module

Pin	Assignment
1	0 Volt
2	Output auxiliary voltage +15 V
3	Output auxiliary voltage –15 V
4	Input setpoint (E+)
5	Input setpoint (E–)
6	Switching input “Controller enable”
7	Switching input “Limit switch 1”
8	Switching input “Limit switch 2”
9	Switching input “Reset fault”
10	Input +24 V for modules P1, P2 and/or E1 (only if fitted)
11	Switching output “Power circuit ready”
12	Switching output “Fault” (or “Ready”)
13	Analog output “Speed monitor”
14	Switching output “Overload”
15	Analog output “Current monitor”
Housing	Connect cable shield to the housing of the SUB-D connector

4.1.3 Position sensor “Lagegeber” (SUB-D female connector X3, 9-pin)

Pin	Assignment
1	0 volt (connect only in special cases)
2	0 volt for motor temperature sensor
3	Sine (S 2)
4	Cosine (S 3)
5	Excitation (R 2)
6	Motor temperature sensor (if there is no sensor, connect to 2)
7	Sine (S 4)
8	Cosine (S 1)
9	Excitation (R 1)
Housing	Connect cable shield to the housing of the SUB-D connector

If the motors has no temperature sensor, then

- connect pins 2 and 6 in the 9-pin connector.

4.1.4 Encoder signals “Gebersignale” (SUB-D male connector X4, 9-pin)

The 9-pin SUB-D connector “Encoder signals” is only fitted when one of the encoder modules (options G1 to G4) is installed.

Pin	Assignment
1	Switching input “Hold” (only with option F1, “Holding control loop”)
2	0 Volt
3	Pulse output phase 1 (U_{A1})
4	Pulse output phase 2 (U_{A2})
5	Pulse output index pulse (U_{A0})
6	Voltage supply encoder module +24 V, only with 24 V version
7	Pulse output phase 1 inverse ($/U_{A1}$), for 24 V vers. not assigned
8	Pulse output phase 2 inverse ($/U_{A2}$), for 24 V vers. not assigned
9	Pulse output index pulse inverse ($/U_{A0}$), for 24 V vers. not assigned
Housing	Connect cable shield to the housing of the SUB-D connector

4.2 Details about the signals

This section describes details about the signals named in the connection assignments. The sequence corresponds to the sequence of connectors given above.

4.2.1 Auxiliary voltage outputs

The two auxiliary voltage outputs are primarily for connecting an external setpoint potentiometer for initial tests (see fig. 8, page 64).

The auxiliary voltage outputs are led via PTC resistors and therefore short-circuit proof. For further details see the table “Technical specifications” (page 16). The auxiliary voltages are only roughly stabilized, their voltage values vary within the given tolerances when the amplifier output is placed under load.

4.2.2 Setpoint through differential amplifier

The setpoint input is applied to a internal differential amplifier with the two inputs E– and E+.

- When correctly connected (see section 4.4.9, page 44), you avoid faults caused by neutral loops with the differential input.

Tip

A positive setpoint (E– positive against E+) results in a clockwise rotation of the motor shaft when looking towards the bearing plate. This applies if

- the costumer module has not been modified.

4.2.3 Switching inputs and switching outputs

Through the switching inputs and switching outputs, the servo amplifier works together with

- with external switches,
- with the primary controller.

4.2.3.1 Properties of the switching inputs and outputs

Two possible polarities by means of polarity module (P module, see also type code):

- Switching towards zero when no polarity module is used (P0 in type code),
- Switching towards positive (PLC-compatible), when polarity module is used (P1 in type code). Positive is
  - either the externally supplied PLC operating voltage (+15...+35 V, preferably +24 V),
  - or the internal auxiliary voltage of +15 V.

The outputs are applied via PTC resistors and are thus

- short-circuit-proof.

Each output can operate a miniature relay (max. 30 mA at max. 35 V).

- The coil must be cleared by a diode.

The specifications are shown in the following table.

Technical data of the switching inputs and switching outputs	"Switching towards zero" version	PLC-compatible version	
		With internal auxiliary voltage	With externally supplied PLC voltage
Input resistor (switching input)	22 kΩ towards +15 V	2.2 kΩ towards 0 V	2.2 kΩ towards 0 V
Output resistor (switching output)	125 Ω towards 0 V	125 Ω towards +14 V	125 Ω towards PLC voltage
Maximum permissible load current	30 mA	10 mA	30 mA
Permissible PLC signal voltage	–	+15 ...+35 V	
Logic level for logical 0	open or >13 V	open or <2 V	
Logic level for logical 1	<2 V	>13 V	

4.2.3.2 Switching input "Controller enable"

At the switching input "Controller enable", the logic level for

- "1" leads to amplifier enabled (motor can run),
  - the green "Ready" LED lights up,
- "0" leads to amplifier disabled.
  - the motor decelerates brakeless,
  - the green "Ready" LED flashes.

Caution

Disabling through the "Controller enable" switching input does not meet the safety requirements of the machine directive.

- If an emergency stop or a safety shutdown of the machine is required,
  - the instructions given in section 7.3 concerning the safety requirements of the machine directive must be followed strictly.

4.2.3.3 Switching input "Reset fault"

The logic level at the "Reset fault condition" input

- must be set to "0" at rest,
- is briefly switched to "1" when a stored fault is to be reset.

For further details on the fault signal and on the fault memory, see section 4.2.10, page 30.

4.2.3.4 Switching output “Fault” or “Ready”

The “Fault” output is present

- when no polarity module (P0) or polarity module P1 is used.

When the servo amplifier is working correctly, then

- the “Fault” output is set to “0”.

If there is a fault, then

- the “Fault” output switches to “1”.

For further details on the fault signal and on the fault memory see section 4.2.10, page 30.

On request, the “Ready” output can be switched instead of the “Fault” output. Since the same connector pin on the control signal male connector is used for both options, the two outputs cannot be present at the same time.

The “Ready” output is inverse to the “Fault” output. It is present

- when the polarity module P2 is used.

When the servo amplifier is working correctly, then

- the “Ready” output is set to “1”.

If there is a fault, then

- the “Ready” output is set to “0”.

For further details on the fault signal and on the fault memory, see section 4.2.10 “Fault memory”, page 30.

If the amplifier is off circuit, then

- the output is disabled, that is, it is at 0 V.

The polarity module P1 can be converted into the polarity module P2 using a solder bridge. For further information, please refer to section 11, “Notes for specialists”, on page 81ff.

4.2.3.5 Switching output “Overload”

When the servo amplifier is being operated within the set continuous current limits, or when peak current is only drawn briefly, then

- the output is “0”.

If the current limiting circuit has switched back from peak current to continuous current due to an overload, then

- the output switches to “1”.

4.2.3.6 Switching output “Motor standstill” or “Power circuit ready”

The “Motor standstill” output is available only

- if the standard version of the Z1 or Z2 add-on module is used.

If the servo motor is operated at a speed greater than 1% of the maximum possible speed,

- the “Motor standstill” output is set to “0”.

If the servo motor runs more slowly, or is at a standstill, then

- the “Motor standstill” output is set to “1”.

On request, the “Power circuit ready” output can be switched instead of the “Motor standstill” output. Since the same connector pin on the control signal male connector is used for both options, the two outputs cannot be present at the same time.

The “Power circuit ready” output reports that the power circuit is ready (that is, functional). It is only available

- if the standard version of the Z4 add-on module or
- if the appropriate special version of the Z1 or Z2 add-on module is used.

The Z1 or Z2 add-on module can be converted from the standard version (“Motor standstill”) into the special version (“Power circuit ready”) by means of a solder bridge. For further information, please refer to section 11, “Notes for specialists”, on page 81ff.

When the servo amplifier

- is working correctly and
- is not disabled, either by the controller enable or by means of a limit switch,
  - then the “Power circuit ready” output is set to “1”.

When the servo amplifier

- is faulty or
- disabled, then
  - the “Power circuit ready” output switches to “0”.

For further details on fault monitoring, please refer to section 4.2.10 “Fault memory”, page 30.

4.2.4 Analog outputs

The analog output “Speed monitor” supplies a

- voltage proportional to the motor speed, the polarity corresponds to the direction of rotation,
  - for example to connect a measuring instrument to display the speed.

The analog output “Current monitor” supplies a

- voltage proportional to the current flowing in the motor, the polarity corresponds to the direction of the torque.

Preconditions:

- Motor correctly connected,
- Motor operating within the voltage limits of the amplifier.

For values of both outputs see table “Technical specifications” on page 16.

4.2.5 Encoder signals, holding function

Encoder signals are available

- only when a encoder module is in position.

Encoder modules are available

- with 5 volt outputs and
- with 24 volt outputs.

For further details see section 6.4, page 55.

The “Hold” switching input is only available

- when the “Holding function” module is in position.
  - The motor can then be shut down with holding torque without the motor shaft continuing to turn slowly. For further details see section 6.5.1, page 57.

4.2.6 Position sensor

The input for the position sensor is dimensioned for the common servo drive-type

- 2-pin resolver (1 pole pair) with a gear ratio of 1 : 0.5.

4.2.7 Motor temperature sensor

At the “Position sensor” connector, the

- motor temperature sensor is also connected.

Check

- If the motor has no temperature sensor, the two connections 2 and 6 in the male connector must be jumpered.

The following are suitable as temperature sensors:

- Thermo switch which opens in case of overheating, or
- PTC resistor, which raises its value to over 2 kΩ in case of overheating.

4.2.8 Sensor fault detection

The position sensor (resolver) and its supply leads are monitored.

- If the resolver breaks down, or
- if one or more resolver leads are interrupted
  - the drive is shut down immediately,
  - the fault memory is enabled,
  - the fault is reported through the “Fault” output,
  - and displayed by the “Fault” LED flashing.

With this fault, the fault memory cannot be reset through the “Reset fault” input, but only by switching the operating voltage off and on again, or the supply voltage in the case of the external supply of the control circuit (module E1).

4.2.9 Block protection

If the motor is blocked, this is not a case of normal operation.

- If the motor is at a standstill for longer than about 4 seconds at maximum current,
  - the drive is shut down, and
  - the fault is reported through the “Fault” output, and
  - through the “Fault” LED flashing.

4.2.10 Fault memory

The following faults do not lead to damage, but to a machine shutdown and to a fault signal:

- overheating of the power circuit,
- overheating of the motor if it is fitted with a temperature sensor,
- short circuit between one or more motor leads and earth or protective earth conductor,
- short circuit between the motor leads,
- faulty internal auxiliary voltage,
- operating voltage too high or too low,
- customer module absent,
- fault in resolver or its supply leads,
- motor blocked for longer than about 4 seconds.

External fault signal (except in the case of overheating, see below):

- “Fault” switching output switches to “1”, and
- “Fault” LED lights up.

The fault is stored (exception “Operating voltage too low”). A fault signal can only be reset when the cause of the fault has been eliminated. To reset

- the switching input “Reset fault” is switched briefly from “0” to “1”. This does not reset “resolver faults”. Or
- the operating voltage is switched off and then on again, or the supply voltage in the case of the external supply of the control circuit (module E1). This also resets “resolver faults”.
  - Before switching back on, wait until the “Fault” LED has gone out.
    - In the case of the external supply of the control circuit (module E1), if the supply voltage is switched off and then on again to reset the fault, the position information stored in the control circuit is deleted.

External fault signal in the case of overheating (power circuit or motor):

- “Fault” switching output switches to “1”, and
- “Fault” LED
  - flashes as long as the temperature limited is exceeded,

– lights up constantly when it has cooled down below the temperature limit.

– Only then can the fault memory be reset.

The operating voltage may reach an excessively high value

- if the motor is braked and the shunt regulator is missing. For further details see section 9.2.2, page 69.

– If the operating voltage is too high, the fault is stored.

If the voltage falls below the minimum permitted operating voltage or, in the case of the external supply of the control circuit (module E1), if it falls below the minimum permitted supply voltage,

- this is reported as a fault through the

– “Fault” switching output and the

– “Fault” LED.

This fault is not stored,

- it disappears when the correct operating voltage has been reached again.

4.3 Interface details

4.3.1 Connector X2, control signals, switching towards zero

The following figure shows the interface details (internal circuit) at the 15-pin SUB-D male connector for the control signals (section 4.1.2.2, page 21)

- for the version without polarity module (switching towards zero)
- for the version with Z1 add-on module
- viewing the connector from the front, that is, looking at the front panel.

In the version without the Z1 module (section 4.2.1.1) the unassigned inputs and outputs are not connected.

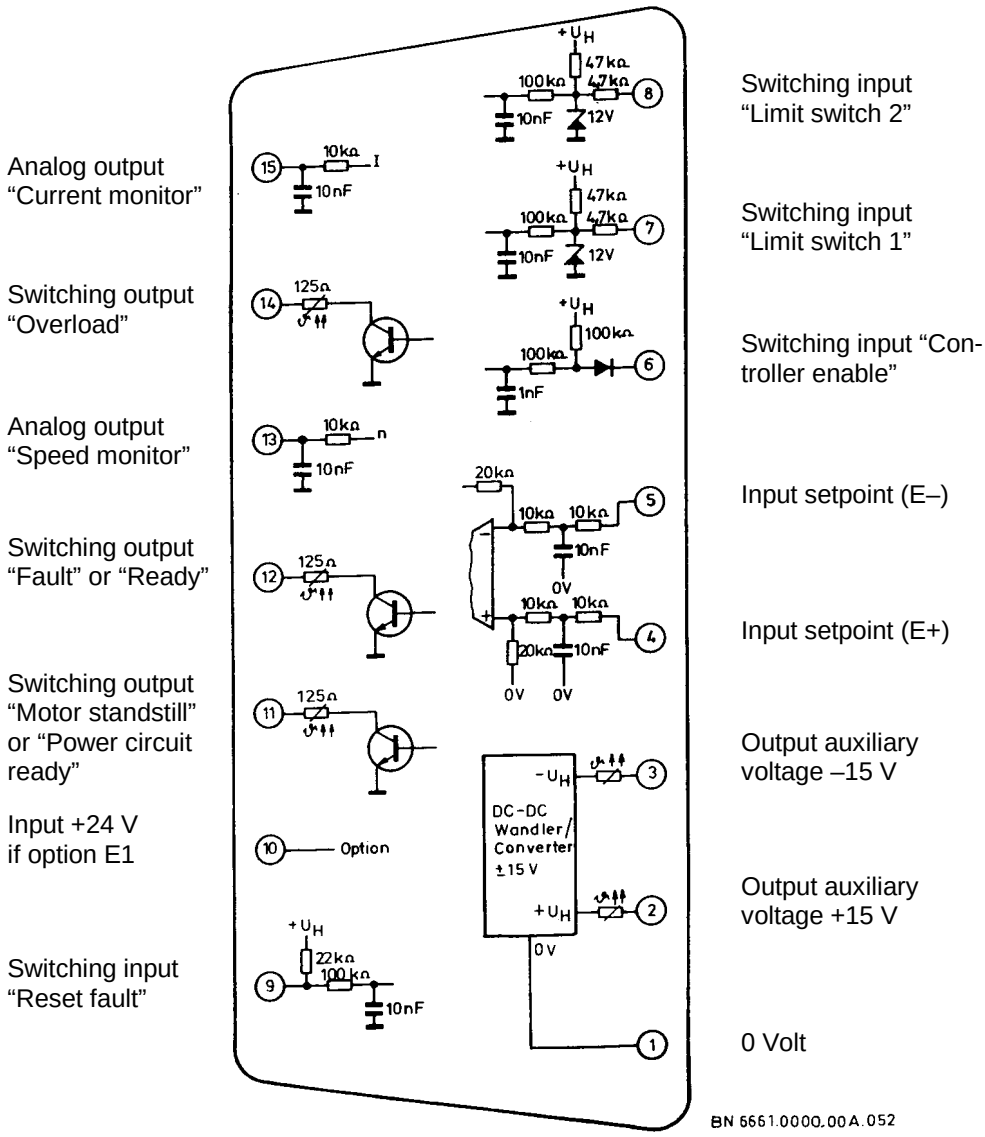


Fig. 2: Control signals, switching towards zero (interface details)

4.3.2 Connector X2, control signals, PLC-compatible

The following figure shows the interface details (internal circuit) at the 15-pin SUB-D male connector for the control signals (section 4.1.2.2, page 21)

- for the version with polarity module (PLC-compatible version)
- for the version with Z1 add-on module
- viewing the connector from the front, that is, looking at the front panel.

In the version without the Z1 module (section 4.2.1.1) the unassigned inputs and outputs are not connected.

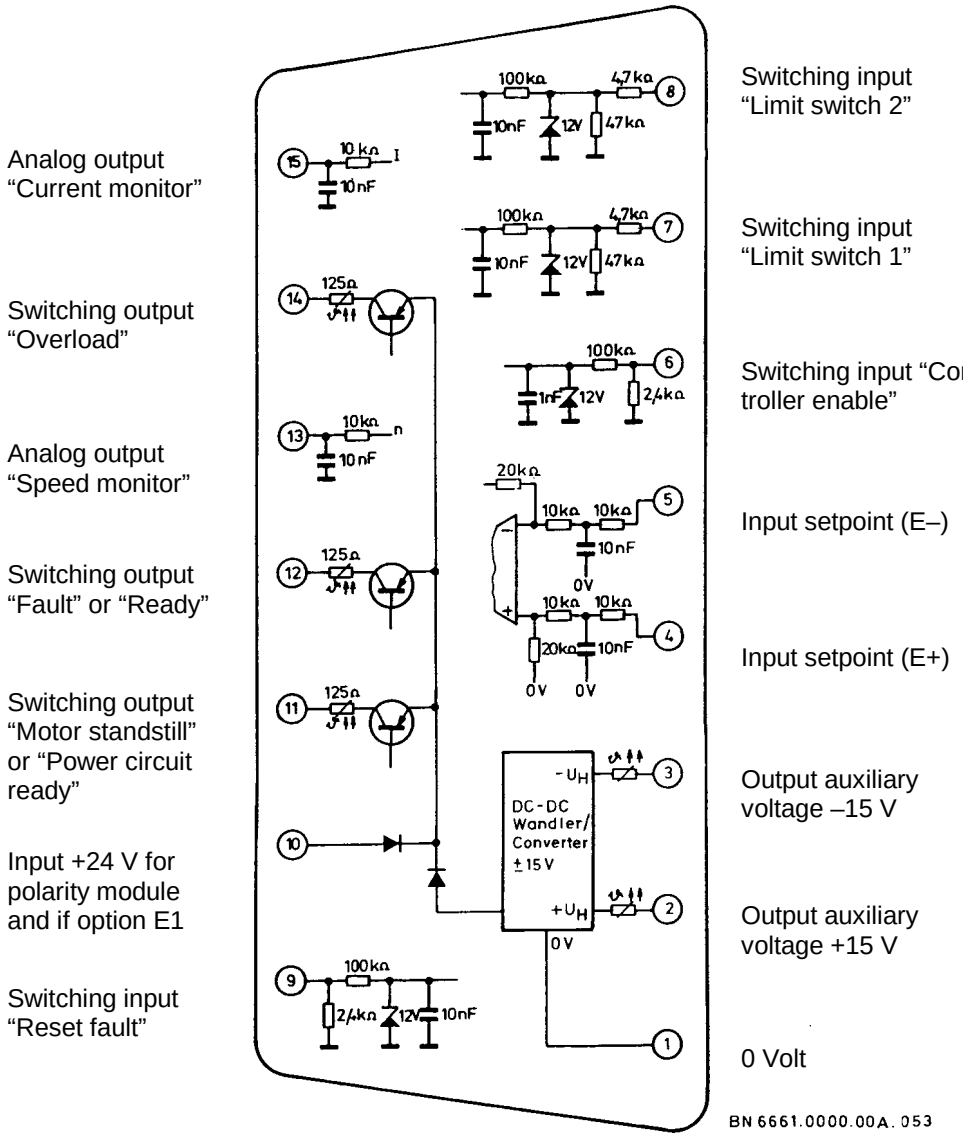


Fig. 3: Control signals, PLC-compatible (interface details)

4.3.3 Connector X4, encoder signals, 5-volt version

The following figure shows the interface details (internal circuit) at the 9-pin SUB-D connector for the encoder signals (section 4.1.4 on page 23)

- for the 5-volt version
- viewing the connector from the front, that is, looking at the front panel.

If the option F1 “Holding control loop” is missing, connection point 1 is not connected.

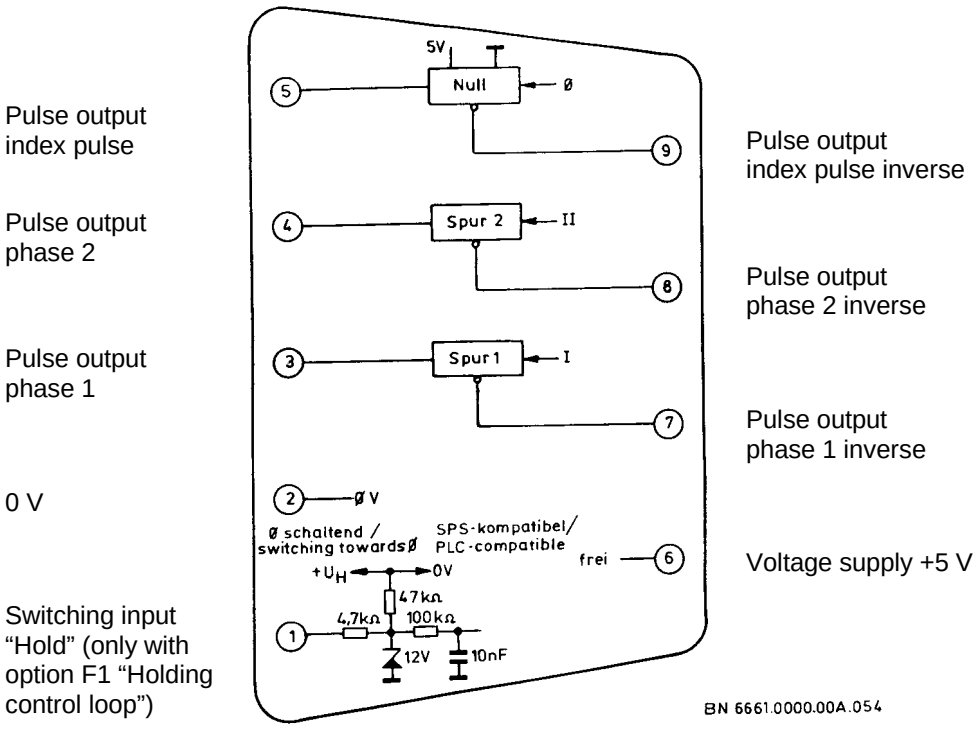


Fig. 4: Encoder signals, 5-volt version (interface details)

4.3.4 Connector X4, encoder signals, 24-volt version

The following figure shows the interface details (internal circuit) at the 9-pin SUB-D connector for the encoder signals (section 4.1.4 on page 23)

- for the 24-volt version
- viewing the connector from the front, that is, looking at the front panel.

If the option F1 “Holding control loop” is missing, connection point 1 is not connected.

Please note

- the separate voltage supply of the output.

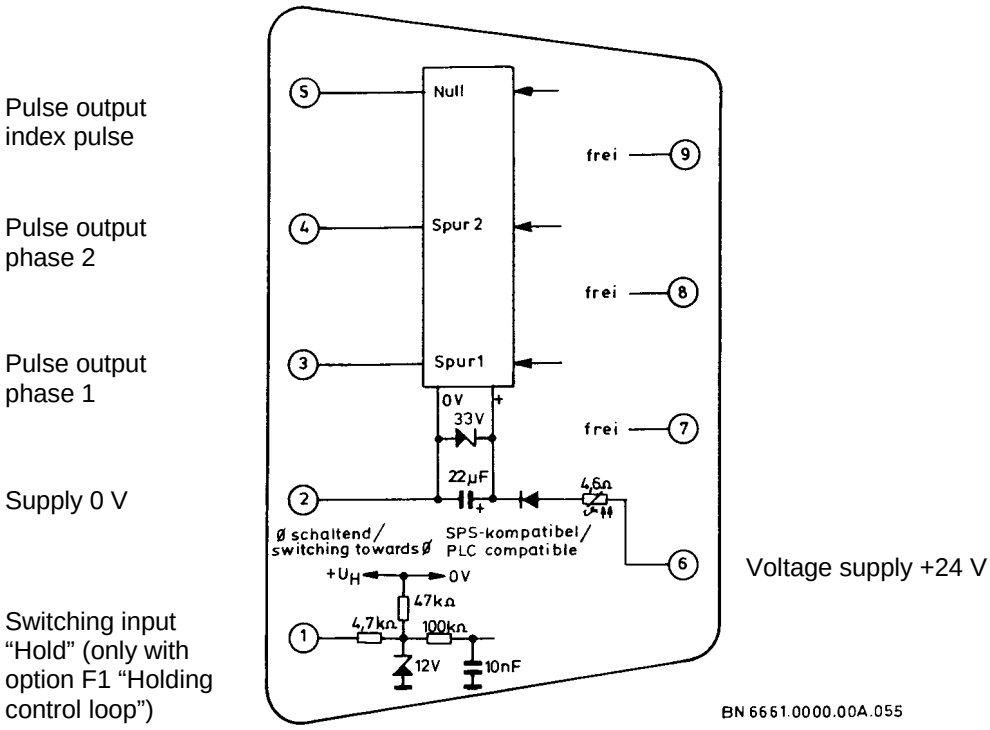


Fig. 5: Encoder signals, 24-volt version (interface details)

4.4 Connection directions

CE/EMC

The EMC limits in accordance with EN 55011, A and B (emission) as well as EN 50082-1 and 2 (immunity) are complied with,

- if the KSV 6HE drive package is connected in accordance with the directions given here.
- Only then is the CE marking valid.

If the connection directions are not complied with,

- the installation in which the amplifiers are being operated must be checked for compliance with the EMC limits at the discretion of the customer.

Figure 6 shows for one axis of the KSV 6HE drive package

- the prescribed connection,
- the design of the plug-in module and of the RFI-filter,
- the laying of the cables and of the potential equilization cables,
- the prescribed earthing of the cable shields using the shield connection plate.

For the two ways of installation, “installation on the mounting plate” and “Installation in a 19" rack system”, fig. 7 shows the arrangement of

- the chassis,
- the RFI-filter with mounted shield connection plate
  - for further details on the shield connection plate 089159 see section 10.2.7, page 80.

4.4.1 Installation on the mounting plate

If you install the chassis on a mounting plate in the control cabinet, screw the chassis onto the bare metal (e.g. zinc-plated) mounting plate

CE/EMC

- with the bare metal rear panel of the chassis.

The mounting plate has to

- be earthed, and therefore
- either carry the central zero point on its own, or

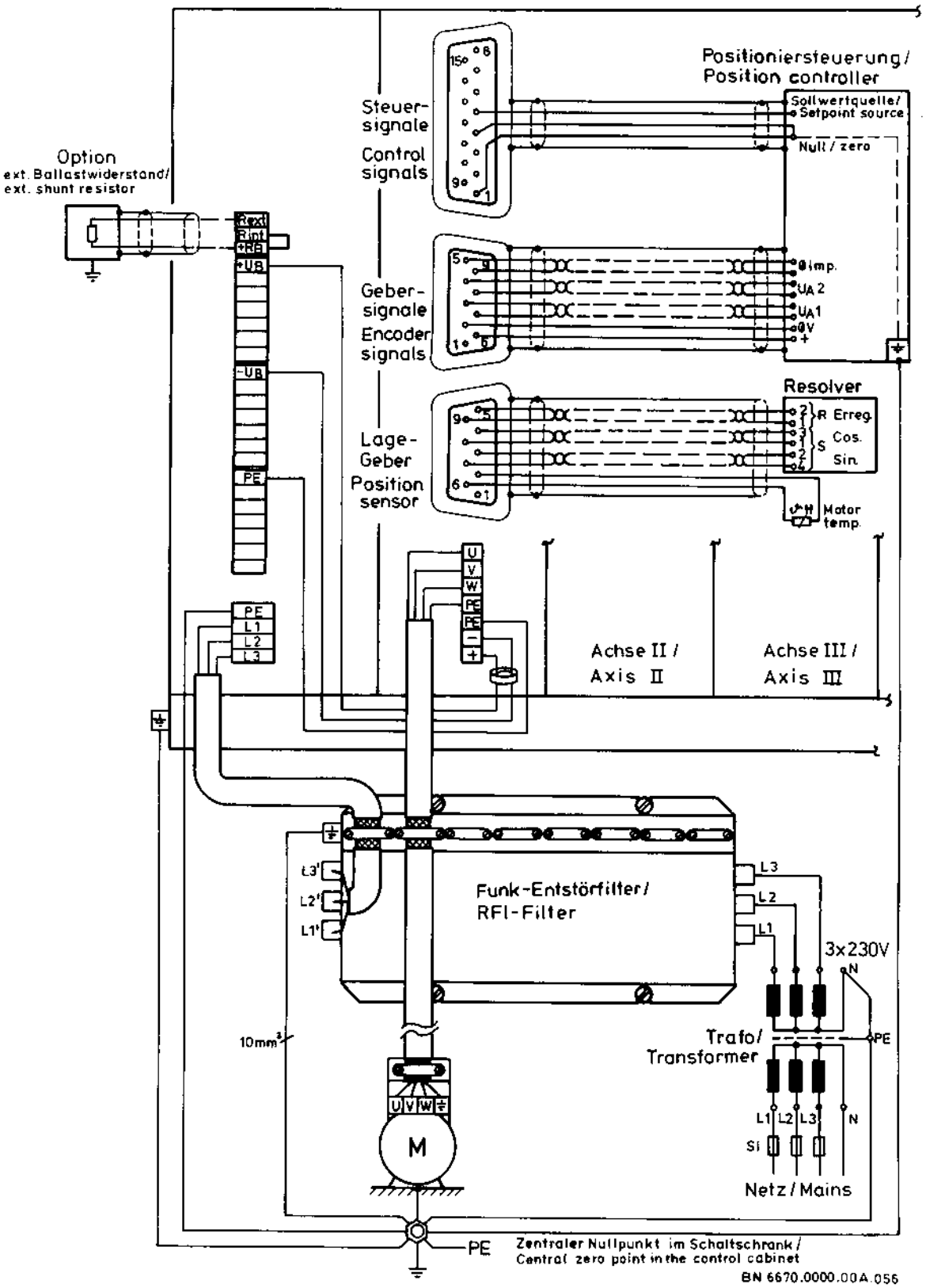
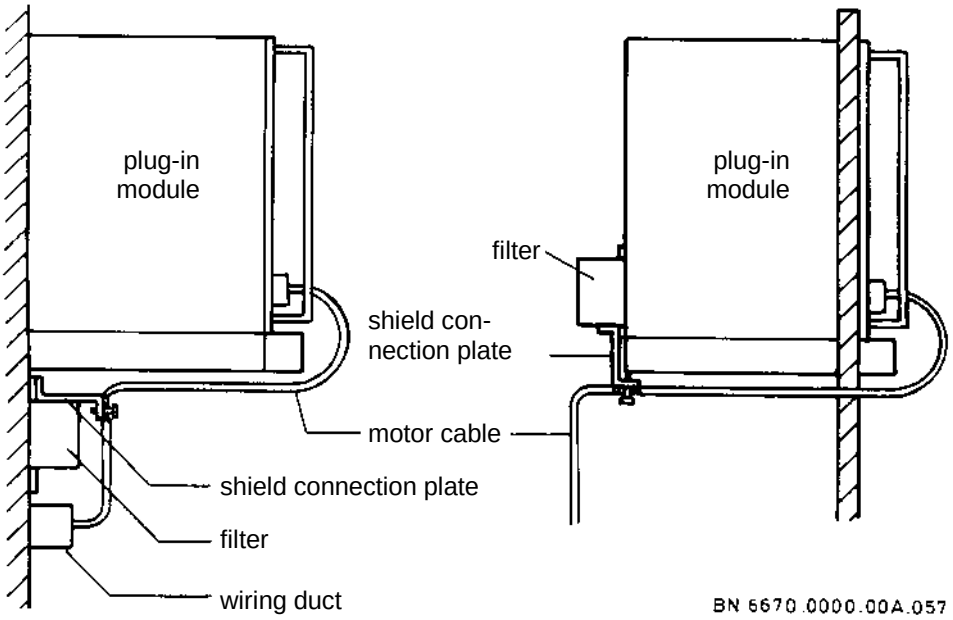


Fig. 6: Connection directions



Installation on a mounting plate Installation in a 19" rack system

Fig. 7: Laying of the motor cables and earthing of their shields

- be connected to the central zero point via a shortest possible potential equilization cable
  - of cross-section 10 mm^2 or more, or better
  - using a wide copper braiding earth strip.

To ensure a well-conducting connection for high frequencies between the housing of the RFI-filter, the mounting plate and the chassis,

- install the RFI-filter directly on the bare mounting plate below the chassis.

Establish the earthing of the motor cable shields at the shield connection plate where the RFI-filter is installed by

- removing a ring-shaped part of the isolating cable sheath and
- clamping the bare shield on the shield connection plate.

The length of the remaining cable between the earthing point of the shield and the connector at the amplifier has to be no longer than 50 cm. It remains shielded. The shield is not connected at the cable's end.

- If you cannot use the shield connection plate, install cable clamps on the mounting plate as close as possible to the RFI-filter.

4.4.2 Installation in a 19" rack system

If you install the chassis in a 19" control cabinet, screw the chassis

CE/EMC

- with its bare metal mounting flanges on the bare metal rack
  - made of chromated aluminum or
  - made of zinc-plated sheet steel
  - with low-resistance earthing, i. e. connected to the central zero point via a shortest possible potential equilization cable
    - of cross-section 10 mm^2 or more, or better
    - using a wide copper braiding earth strip.
- Do not use varnished or anodized racks.

To ensure a well-conducting connection for high frequencies between the housing of the RFI-filter (see section 4.4.4) and the chassis,

- install the RFI-filter directly on the rear wall of the chassis. Suitable mounting holes are located there.

Establish the earthing of the motor cable shields at the shield connection plate where the RFI-filter is installed by

- removing a ring-shaped part of the isolating cable sheath and
- clamping the bare shield on the shield connection plate.

The length of the remaining cable between the earthing point of the shield and the connector at the amplifier has to be no longer than 50 cm. It remains shielded. The shield is not connected at the cable's end.

Leave a gap below the chassis

- Under the chassis, lay the cable from the power supply to the filter via the shield connection plate to the back.
- Lead the motor cables under the plug-in module to the back via the shield connection plate into the general control cabinet cabling.

4.4.3 Potential equilization cables

Figure 6 shows potential equilization cables. They come from the central zero point of the control cabinet. Their tasks are:

- they form a low-resistance connection between various zero points,
- they reduce compensating current on the cable shield
  - and thus prevent electrical faults.

The central zero point of the control cabinet is connected to the PE (protective earth) conductor. This connection

Danger

- ensures protection of the operating and maintenance personnel in case of electrical faults.

Due to leakage current from the RFI filter, the potential equilization cable from the central zero point to the PE bolt of the RFI-filter must, in accordance with DIN VDE 0160 (like the protective earth conductor)

- have a cable cross-section of at least 10 mm^2 Cu.

The other potential equilization cables must have

- a cross-section of at least 2.5 mm^2, or preferably 4 mm^2.

It is true that drives can run without potential equilization cables, without shielded cables and without compliance with safety regulations. However, this

Do not

- is contrary to elementary safety requirements,
- violates statutory regulations and
  - endangers the safety of persons,
  - endangers the operational safety of the system and
  - may lead to faults from and in other parts of the system.

4.4.4 Mains connection

4.4.4.1 Connection mains – mains transformer

The mains transformer

- is chosen corresponding to the technical specifications of the transformers in section 9.3.3, page 73.

The connections are clearly labeled at the terminals of the transformers.

The cable between mains and the transformer

- is led through line-side fuses, see the table on page 73 for values,
- must have an adequate cross-section for the chosen mains transformer given in the same table,
- must have a fixed connection.
- Shielding is not required.
- Connect PE to earth.
- The secondary neutral point has to be earthed.

If more than one power supply is connected to one mains transformer

- the bus voltages (i. e. the outputs) of these power supplies must not be connected.

4.4.4.2 Connections mains transformer – RFI-filter– power supply

In any case, as shown in fig. 6, switch in the connection between mains transformer and power supply

CE/EMC

- a RFI-filter matching the chosen transformer, see table “Technical specifications of the mains transformers”, page 73.
- The mounting of the RFI-filter is described above.
- Connect PE to earth (cable cross-section according to DIN VDE 0160 of min. 10 mm^2).

The connections are labeled at the terminals of the RFI-filter according to fig. 6.

The connection between transformer and RFI-filter

- must have an adequate cross-section for the chosen mains transformer, see the table on page 73.
- Shielding is not required.

CE/EMC

The connection between RFI-filter and power supply

- must not be longer than 50 cm,
- must have an adequate cross-section for the chosen mains transformer, see the table on page 73,
- has to be shielded,
  - the shield is large-area earthed with a cable clamp of the shield connection plate on the RFI-filter.
- Unshielded cable ends must not be longer than 5 cm. Therefore the shield must not end at the earthing clamp, but has to continue.

4.4.4.3 Connection power supply – servo amplifier

CE/EMC

The power supply has terminals to connect the amplifiers installed in the chassis (section 9.2.3, page 69). Connect

- the positive and negative operating voltage as well as the corresponding earth (PE) from the power supply to the amplifier
- inside the wiring duct as shown in fig. 6

- via short three-core wiring connections,
  - for the necessary cable cross-section see table “Technical specifications”, page 16.
- Do not lay other cables (motor cables, control cables) parallel to this connection in the wiring duct.
- Lead the two wires for the operating voltage (but not the PE lead) through a ferrite ring 042103010 (section 10.2.5, page 78) directly at the amplifier input as shown in fig. 6.

4.4.5 Motor connection, general information

For the motors supplied by Georgii Kobold, the connection is given in the motor connection sheet shipped with each motor. To connect other motors not supplied by us, please contact us.

Check

The 3 motor phases must be connected with the correct assignments, otherwise

- the motor blocks,
- the motor runs roughly,
- the motor runs with a low torque, or
- the motor runs uncontrolled at full speed.
  - This causes no damage either to the motor or to the amplifier, but there is a risk for the machine and the installation personnel.

Danger

CE/EMC

As shown in fig. 6, the motor is connected using a 4-pin shielded cable.

- Use the motor supply cable described in the accessories, for further details see section 10.2.3 on page 76.
- Establish the earthing of the motor cable shields at the shield connection plate where the RFI-filter is installed as described above in the context of figures 6 and 7.
- Establish a large-area connection between the shield and earth at the motor in a suitable manner.
  - At all places, avoid earthing the shield using twirled strands (pigtails) of the shield.
- Connect the machine earth to the central zero point of the control cabinet using an potential equilization cable with an adequate cross-section.

The shield of the motor cable must not be interrupted.

- If you have to install contactors, switches or chokes in the motor cable,
  - then install these in a metallic housing and
  - establish a large-area connection between the shield and the housing using a cable clamp, as described above.

The motor cables

- have to leave the control cabinet at shortest possible distance,
- must not be laid parallel to sensible control leads or unshielded mains cables.
  - If parallel arrangement cannot be avoided, ensure a distance of min. 25 cm to the other cables.

4.4.6 Motor choke

CE/EMC

Longer motor cables can overload the device and lead to intolerable high emission.

- If the motor cable is longer than 7 m,
  - install the appropriate motor choke supplied by us in the motor cable at the amplifier side.

For cable lengths, order numbers and technical specifications of the chokes, please refer to section 10.2.6, page 78.

4.4.7 Shield connection of the external shunt resistor cable

If an external shunt resistor is connected (see section 9.2.6, page 71 for further details)

- use a shielded cable,
- connect the shield with the earthed housing of the shunt resistor using a cable clamp at the housing, as shown in fig. 6.

4.4.8 Connection, shielding and laying of the control leads

CE/EMC

These notes on connection, shielding and laying of the control leads apply for the following three sections.

- Use only shielded leads.

- The SUB-D connectors must have metal-plated housings, like the connectors supplied by us.
  - There, the shield is connected with a low resistance to the housing via the strain relief.
- This allows you to achieve the necessary large-area earth connection for the shield and
  - to avoid earthing the shield using twirled strands (pigtails) of the shield.

Do not lay control leads parallel to motor cables or to connections between power supply and amplifier in the wiring duct.

4.4.9 Setpoint connection

When connecting the setpoint source (top in fig. 6)

- ensure that earthing and shielding have been correctly carried out,
  - to avoid faults at the amplifier input,
  - to prevent faults at the setpoint source.
- First precaution: shield the setpoint lead.
  - Connect the shield on the setpoint source to the appropriate zero.

In particularly critical cases

- to avoid sheath current, install an potential equilization cable on the shield parallel to the setpoint lead, with a cross-section of at least 2.5 mm^2. Or
- apply only a high-frequency shield on the side of the setpoint source using a low-induction capacitor (e.g. 10 nF, 400 V).

Tip

Always use the differential input,

- this prevents zero loops, that is, the coupling of interference via the input zero.
  - Apply the setpoint at input E–.
  - Connect input E+ with zero at the setpoint source.

4.4.10 Connection of the encoder signals

Figure 6, top right, shows the connection of the encoder signals to a positioning controller. Please note:

- Choose twisted pair cables for the 5-volt version.

- Use a shielded cable
  - for example the resolver/encoder connecting cable mentioned in the accessories, for further details see section 10, page 75ff.
  - Connect the shield at the amplifier to the earthed amplifier housing using the metal-plated SUB-D housing.
  - Additionally, earth the shield at the controller,
    - follow the recommendations of the controller manufacturer concerning earthing and shield connection.

4.4.11 Connecting the position sensor (resolver)

The connection cable to the position sensor (resolver) must

- be laid separate from the motor cable,

Check

- be connected exactly according to the instructions, otherwise
  - the motor blocks,
  - the motor runs roughly
  - the motor runs with a low torque
  - the motor runs uncontrolled at full speed, or
  - the servo amplifier reports a fault.

Danger

    - This causes no damage either to the motor or to the amplifier, but there is a risk for the machine and the installation personnel.

To connect up the resolver as shown in fig. 6

- use twisted pairs of leads for channel 1, channel 2 and excitation,
  - for example the resolver/encoder connection cable mentioned in the accessories; for further details see section 10.2.4, page 77,
- connect the shield using the strain relief of the metal-plated SUB-D housing,
  - this allows you to achieve the necessary large-area earth connection for the shield and
    - to avoid earthing the shield using twirled strands (pigtails) of the shield.
- Do not connect the shield at the motor side.

4.4.12 Connection of the motor temperature sensor

The motor temperature sensor is connected via the cable for the position sensor and its connector.

- If the motor has no temperature sensor,
  - the two connecting points provided for this purpose in the 9-pin male connector of the position sensor are connected to each other.

5 Adjustment and display elements

The adjustment and display elements contained in all KSV 6HE versions are described here. Special information for the versions with expansion modules is given with the appropriate options.

5.1 Trim potentiometers

3 trim potentiometers are accessible on the front panel of the amplifier. Their significance is, in the sequence from top to bottom:

Front panel	Schematic diagram	Description	Effect with clockwise rotation
Feedback “Verstärkung”	P 1	Amplification speed control circuit	Amplification rises
Speed “Drehzahl”	P 2	Speed adjustment	Speed rises
Offset “Nullpunkt”	P 3	Offset adjustment	

If the module F1 for activating the holding control loop is fitted, the trim potentiometer “Hold” (“Halten”) is located on the customer module (P4 / gain holding control loop). The trim potentiometer “setpoint gain” (“Sollwertverstärkung”) can be installed on the customer module as an option.

5.2 Current limiting and “Current” rotary switch

A current limiting device with I^2t function protects the motor and the amplifier. From the unloaded state, a maximum current equivalent to the preset peak current is possible.

- If the square of this exceeds a certain given threshold value for a certain time,
  - then the current is reduced to the value of the preset continuous current, and an external “Overload” signal is given.

  The amplifier can be operated for any length of time in this state. If the current is reduced, the “Overload” state is canceled after some time.

The 16-position rotary switch "Current" ("Strom") for setting the current limit is located at the top of the PCA, approximately 100 mm behind the customer module. It is not accessible from outside so that it cannot be adjusted unintentionally. The assignment of the switch positions to the values for the motor current limit (continuous current

I_D as rms value and peak current I_I as crest value) is shown in the following table.

Servo amplifier	KSV 1,5/5		KSV 3/10		KSV 6/20		KSV 9/30		KSV 12/30	
"Current" switch	Cont. current I_D (A)	Peak current I_I (A)	Cont. current I_D (A)	Peak current I_I (A)	Cont. current I_D (A)	Peak current I_I (A)	Cont. current I_D (A)	Peak current I_I (A)	Cont. current I_D (A)	Peak current I_I (A)
0	0.38	1.25	0.75	2.5	1.5	5.0	2.25	7.5	3.0	7.5
1	0.45	1.5	0.9	3.0	1.8	6.0	2.7	9.0	3.6	9.0
2	0.53	1.75	1.05	3.5	2.1	7.0	3.15	10.5	4.2	10.5
3	0.6	2.0	1.2	4.0	2.4	8.0	3.6	12.0	4.8	12.0
4	0.68	2.25	1.35	4.5	2.7	9.0	4.05	13.5	5.4	13.5
5	0.75	2.5	1.5	5.0	3.0	10.0	4.5	15.0	6.0	15.0
6	0.83	2.75	1.65	5.5	3.3	11.0	4.95	16.5	6.6	16.5
7	0.9	3.0	1.8	6.0	3.6	12.0	5.4	18.0	7.2	18.0
8	0.98	3.25	1.95	6.5	3.9	13.0	5.85	19.5	7.8	19.5
9	1.05	3.5	2.1	7.0	4.2	14.0	6.3	21.0	8.4	21.0
A	1.13	3.75	2.25	7.5	4.5	15.0	6.75	22.5	9.0	22.5
B	1.2	4.0	2.4	8.0	4.8	16.0	7.2	24.0	9.6	24.0
C	1.28	4.25	2.55	8.5	5.1	17.0	7.65	25.5	10.2	25.5
D	1.35	4.5	2.7	9.0	5.4	18.0	8.1	27.0	10.8	27.0
E	1.43	4.75	2.85	9.5	5.7	19.0	8.55	28.5	11.4	28.5
F	1.5	5.0	3.0	10.0	6.0	20.0	9.0	30.0	12.0	30.0

If the desired type of motor is given in the order, the current is factory-set to the permissible motor current. If not, the "Current" rotary switch is set to position 5.

Tip

If you have changed the factory settings, it is essential that you should document the new switch position in the table in section 12, page 90.

5.3 LEDs

There are three LEDs on the front panel of the amplifier:

Check

Marking	Color	Display
Fault “Störung”	red	• lights up when fault is stored • flashes as long as power circuit or motor is overheated • flashes in the event of a resolver fault
Ready “Bereit”	green	• lights up when amplifier is ready • flashes when amplifier is disabled • flashes when fault is stored
Overload “Überlast”	yellow	• lights up when switched from peak current to continuous current in the event of an overload

When the mains voltage is switched on, the amplifier remains disabled until all voltages are stable. During this time, which lasts for some tenths of a second, the red LED lights up.

6 Modular fittings and expansions

This section describes the functions of the modules. The modules of a special KSV 6HE servo amplifier are given in a special type code (as initials). For further details on the type code, see section 3.1, page 15. The modules are called:

- Customer module (“**K**undenmodul”)
- Add-on module (“**Z**usatzmodul”)
- Polarity module (“**P**olaritätsmodul”)
- Encoder module (“**G**ebermodul”)
- Function module (“**F**unktionsmodul”)
- **E**xternal supply for control circuit

Not all modules are real boards, variants that have been implemented differently are also possible.

6.1 Customer module Kx

The pluggable customer module contains

- all assemblies to be set during installation,
- assemblies for special features such as current control or speed control.

Tip

When an amplifier is replaced, the customer module can be transferred to the new amplifier. Readjustment is therefore not necessary. The customer module is fitted in all versions.

To replace the customer module

- remove fixing bolt and take out the module.

The customer module is located on the left.

Amplifiers equipped with different customer modules differ also in the arrangement of the jumpers on the amplifier board.

6.2 Add-on modules Zx

Many additional characteristics can be implemented by means of add-on modules. The mode of operation of the Z1, Z2, and Z4 add-on modules is described in the following, further add-on modules are available on request.

6.2.1 Add-on module Z1

Additional characteristics when fitted with the Z1 add-on module:

- 2 limit switch inputs, directional, braked,
- controller enable, braking in case of shutdown, can be switched to non-braking using a solder bridge,
- switching output internally selectable, “Motor standstill or “Power circuit ready”,
- peak current can be switched off by means of a solder bridge,
- ramp function, can be switched on by means of a solder bridge.

Using the limit switch inputs, the motor is

- shut down depending on the direction of rotation, and is actively braked by reversal.

The ”Controller enable” input also

- actively brakes the motor by reversal. Active braking can be switched off.
  - For conversion by the specialist see section 11.3, page 85.

An additional switching output supplies

- the “Motor standstill” signal or
- the “Power circuit ready” signal as a special version.
  - For conversion to the version with the “Power circuit ready” signal see section 11.3, page 85.

If the peak current rise is to be switched off, a solder bridge must be installed,

- for further details see section 11.3, page 85.

The ramp function is not active as delivered. To activate it, a solder bridge must be installed,

- for further details see section 11.3, page 85.

The ramp rise can be set with a potentiometer on the add-on module. The potentiometer is marked with two ramp symbols.

- Left-hand limit: slope of 7 ms per 1 V of setpoint voltage,
- right-hand limit: slope of 70 ms per 1 V of setpoint voltage, that means: a setpoint jump of 10 volts leads to a linear rise of the internally effective setpoint within 0.7 seconds.

The ramp function is effective in all 4 quadrants. It is also effective

- when actuating a limit switch and
- when actuating the controller enable.

Please note: the Z1 add-on module is practical only for speed-controlled drives. In a KSV 6HE amplifier configured for current control, the functions “Limit switch” and “Controller enable” do not have a braking effect.

Tip

It is essential that you should document all changes in the table in section 12, page 90.

6.2.2 Add-on module Z2

Additional characteristics when Z2 add-on module is fitted:

- externally adjustable current reduction,
- externally switchable setpoint reversing (for PLC with single-pole analog output),
- controller enable, braking in case of shutdown, can be switched to non-braking using a solder bridge,
- switching output “Motor standstill” or “Power circuit ready” internally selectable,
- peak current can be switched off using a solder bridge,
- ramp function, can be switched off using a solder bridge.

The external analog input “Current reduction” proportionally reduces the current limit set with the “Current” selector switch:

- If the input is open, or if it is set to +10 V,
  - the current limit has the effect which has been set at the “Current” selector switch.
- If there is a voltage of less than +10 V at the input,
  - the current limit is reduced proportionally. First only the peak current is reduced. Only when the current limit is lowered by the external setpoint below the peak current value, the continuous current is also reduced.
- Values of over +10 V do not cause a higher current than 100%, and values of less than +0.1 V do not cause a lower current than 1% of the set value.

The peak current rise can be switched off,

- for conversion by the specialist see section 11.3, page 85.

The additional switching input “Setpoint reversing”

- reverses the polarity of the setpoint internally.
  - If it is open or set to “0”, the setpoint leads to the same direction of motor rotation as without the module.
  - If it is switched to “1”, the direction of the motor rotation is reversed.

The “Controller enable” input

- actively brakes the motor by reversal. Active braking can be switched off.
  - For conversion by the specialist see section 11.3, page 85.

An additional switching output supplies

- the “Motor standstill” signal or
- the signal “Power circuit ready” as a special version.
  - For conversion to the version with the “Power circuit ready” signal see section 11.3, page 85.

  The ramp function is not effective as delivered. To activate it, a solder bridge must be installed,
- for further details see section 11.3, page 85.

The ramp rise can be set with a potentiometer on the add-on module. The potentiometer is marked with two ramp symbols.

- Left-hand limit: slope of 7 ms per 1 V of setpoint voltage,
- right-hand limit: slope of 70 ms per 1 V of setpoint voltage, that means: a setpoint jump of 10 volts leads to a linear rise of the internally effective setpoint within 0.7 seconds.

6.2.3 Add-on module Z4

Check

The customer module labeled “P+I/I-lim” has to be installed when using the Z4 add-on module.

Additional characteristics when fitted with the Z1 add-on module:

- speed control with limitation of the I component,
- 2 limit switch inputs, directional, braked,
- controller enable, braking in case of shutdown, can be switched to non-braking using a solder bridge,
- switching output “Power circuit ready”,
- peak current can be switched off by means of a solder bridge,

The speed control loop is divided

- in the P component (P controller)
  - adjustable with the “Feedback/Verstärkung” potentiometer on the front panel
- and the I component (I controller).
  - The I time constant can be selected by solder bridges on the Z4 add-on module (for further details see section 11.3.7, page 88).

For overshoot suppression in the speed control loop

- the I component can be limited.
  - The limitation threshold can be selected by solder bridges on the Z4 add-on module (for further details see section 11.3.7, page 88).

Tip

For the purpose of commissioning, a special module is available on which

- potentiometers for I time constant and limitation threshold are mounted.

The special module is not suitable for normal operation, because the potentiometers

- can only be adjusted when the device is open.

Using the limit switch inputs, the motor is

- shut down depending on the direction of rotation, and is actively braked by reversal (PLC-compatible).

The ”Controller enable” input also

- actively brakes the motor by reversal. Active braking can be switched off.
  - For conversion by the specialist see section 11.3, page 85.

An additional switching output supplies

- the “Power circuit ready” signal (PLC-compatible).

If the peak current rise is to be switched off, a solder bridge must be installed,

- for further details see section 11.3, page 85.

Tip

It is essential that you should document all changes in the table in section 12, page 90.

6.2.4 Further add-on modules

Further add-on modules are available as

- customer-specific solutions specially adapted to the application.

6.3 Polarity module Px

The function of the polarity module has already been described in section 4.2.3.1 on page 24: it ensures that the switching inputs and outputs are PLC-compatible, that is, that they switch towards +24 V. If it is not implemented, these inputs and outputs switch towards zero.

6.4 Encoder modules G1 to G4

Application of the encoder signals:

- Connection of positioning controls
- Connection of a digital speed counter for monitoring the motor speed.

For all encoder modules, 16 different pulse numbers can be set.

Encoder signals are available only if the encoder module is fitted. For the various encoder modules see type code, section 3.1 on page 15:

- Standard G1 encoder module: outputs like standard incremental encoder:
  - 5 volt push-pull, RS 422 interface with SN 75114 line driver,
  - phase 1, phase 2, index pulse and corresponding complement, that is 6 lines,
  - outputs electrically connected to the amplifier circuit.
- G3 encoder module: characteristics like G1, but in addition with:
  - adjustable index pulse. The index pulse can be shifted in 256 steps within one motor revolution. For further details see section 6.4.2, page 56.
- G2 encoder module:
  - pulse output for 24 volts, interface push-pull outputs, actively switching towards zero and towards +24 volts,
  - phase 1, phase 2 and index pulse without complement over 3 lines,
  - outputs electrically connected to the amplifier circuit,
  - outputs short-circuit-proof,

  - external supply as with incremental encoders with +24 V ±20%.
- G4 encoder module: characteristics like G2, but in addition with:
  - adjustable index pulse. The index pulse can be shifted in 256 steps within one motor revolution. For further details see section 6.4.2, page 56.

Tip

The following applies for all encoder modules:

- When the motor shaft rotates clockwise, looking towards the bearing plate, phase 2 lags behind phase 1. This corresponds to the definition with the output impulses of an incremental encoder.
- With all pulse figures, the index pulse – like standard incremental encoders – has half the width of the pulses from phase 1 and phase 2.

6.4.1 Pulse setting

A rotary switch with 16 positions on the encoder module is for setting the pulse number. The following applies:

Switch setting	Pulses per revolution	Switch setting	Pulses per revolution
0	128	8	500
1	256	9	1000
2	512	A	90
3	1024 *	B	180
4	50	C	360
5	100	D	720
6	200	E	900
7	250	F	60 **

* standard factory setting

** specially intended for speed display with frequency meter. Gives direct revolutions per minute if the display is set to Hz.

Tip

It is essential that you should document the switch position in the table in section 12, page 90, if you have changed the factory settings.

6.4.2 Index pulse adjustment

With the G3 and G4 encoder modules (adjustable index pulse) the position of the index pulse can be shifted within a motor revolution. For this purpose the encoder module has two rotary switches “Rough” and “Fine”, and three LEDs.

- The “Rough” switch shifts the pulses by 22.5° per step,
- the “Fine” switch shifts them by approx. 1.4° per step.
- The “Zero” LED indicates the index pulse, that is, the moment when the output level is “High”.
- The “Rough” and “Fine” LEDs light up when the index pulse is within the setting range of the appropriate switch.

Adjustment instructions:

1. Turn the motor shaft to where the index pulse should be.
2. Turn “Fine” switch until the “Fine” LED lights up,
3. Turn “Rough” switch until the “Rough” LED lights up.

Tip

As with incremental encoders, the index pulse here also has the width of an increment. The index pulse can be adjusted in steps of approx. 1.4° with the two switches. This corresponds to a resolution of 256 steps on the circumference. When a pulse figure of over 256 is set, then the index pulse is narrower than 1/256 of the circumference. For this reason, the “Zero” LED does not light up within the entire adjustment window of 1.4°. For it to light up, the motor shaft must be rotated within the window to the exact zero point.

6.5 Function module Fx

Various functions, including customer-specific functions, are implemented on the function module. So far, there are the hold function and the field weakening mode, which will be described in the following.

6.5.1 Hold function F1

Disadvantages of conventional servo drives when the motor is at a standstill:

- If the controller enable is canceled, the motor is at a standstill without torque,
- If the torque setpoint is made zero, the motor comes to a standstill with holding torque, but due to the offset drift of the speed controller it rotates slowly in the one or the other direction.

These disadvantages can be avoided if the F1 “Hold function” module is used. In many cases the magnetic brake, which is otherwise necessary, is no longer required.

Mode of operation of the hold function: when the hold command is entered at the “Hold” input through logical “1”, then

- the external setpoint is switched off internally.
- The internal holding control loop digitally saves the position of the motor at the moment the command was given.
- The holding control loop returns the motor to this position and holds the motor in this position with its full torque.

The holding control loop monitors the position within one revolution. If the motor has required more than one revolution to come to a standstill from a higher speed due to inertia, these revolutions are not recalled.

Example of a simple positioning solution:

- A pre-sensor reduces the speed of the motor in good time before the position so that later no more than a single revolution will be needed to brake the motor,
- a sensor gives the hold command at the position,
- the motor brakes and the internal holding control loop recalls it to the switching point of the position sensor.

Caution

In many cases the holding control loop makes a magnetic brake on the motor superfluous. If the safety aspects derived from the machine directive require the brake, however, it cannot be replaced by the holding control loop.

6.5.2 Field weakening mode F2

In AC servo drives, the maximum speed that can be reached can be increased at reduced torque by shifting the phase of the motor current at higher speeds. Since the phase-shift results in a weakening of the torque-forming part of the magnetic rotary field, this operating mode is also called “Field weakening mode” by analogy with the terms used for DC drives.

The F2 function module “Field weakening mode” shifts the phase of the motor current in the desired direction from a predefined speed, depending on the direction of rotation. This predefined speed is factory-set on a trim potentiometer on the module. This setting must not be changed.

6.6 Option E1 external supply of control circuit

In the standard version, the E1 module “External supply of control circuit” module is not fitted. When the supply voltage is switched off,

- the position information disappears.

The version with the E1 module “External supply of control circuit” has an input for the separate feeding of a supply voltage of 24 V (see table “Technical specifications”, page 16, for connection see section 4.1.2, page 20). When the supply voltage is switched off,

- the position information is saved as long as the external supply voltage is connected.

This module is used

- when (for example in case of an emergency stop) the supply voltage of the amplifier is switched off and
- the position information must be saved.

The “External supply of control circuit” module is not a pluggable module, but a modular variation which cannot be retrofitted on site.

7 Shutting down the motor and safety shutdown

7.1 Shutting down options

Options for shutting down the motor:

- Disabling through the “Controller enable” input
  - without Z1, Z2, or Z4 module: the motor decelerates brakeless,
  - with Z1, Z2, or Z4 module: the motor is actively braked by reversal.
- Switch off via limit switch (only with Z1 or Z4 module), directional:
  - motor is actively braked by reversal.
- Switch off the speed setpoint (set setpoint to 0 volts):
  - motor is actively braked by reversal.
- Switch off the supply voltage:
  - motor decelerates brakeless,
  - the position information is lost.

  When switching off the supply voltage, please note the tip on page 62.
- Switch off in the motor supply line
  - without braking resistors: motor decelerates brakeless,
  - with braking resistors: motor is braked by withdrawal of kinetic energy (less effective than active braking by reversal).

    Braking resistors' effect increases as their resistance value falls; the maximum permissible peak current given in the data sheet for the motor may not be exceeded by that. If no value is given, assume that the limit is three times the continuous current.
    - Switching sequence when switching off in the motor supply line:
      - first, disable the amplifier (using controller enable),
      - then open the motor line (no delay is required between the two operations, since the power contactor is slower than the disabling operation).
    - To switch on again,
      - first close the motor line,
      - then enable the controller (Delay necessary, depending on the power contactor, for example 20 ms or more).

If the braking time is too long with the selected manner of shutting down the motor, the motor can be fitted with a magnetic brake which acts using spring power when the current is switched off.

7.2 Estimating the braking distance

The braking distance of the connected machine part depends on the moment of inertia of the drive and on the mass of the part to be moved (e.g. of the machine carriage).

Example (assumed values):

- Braking time for active braking (limit switch or zeroing of setpoint) 0.1 seconds,
- linear braking from a velocity of 10 meters per minute,
- results in a braking distance of approx. 8 millimeters.
  - This means that with the values of this example, the setpoint must be set to zero at least 8 millimeters before the mechanical limit stop if the stop is not to be struck hard.

7.3 Emergency stop and safety regulations

Do not

The safety regulations to be derived from the machinery directive do not allow safety functions to be carried out by electronic circuits, since the risk of failure cannot be fully ruled out.

- An emergency stop or any other safety circuit must not only be effected by zeroing the setpoint or by using the controller enable.

With emergency stop switches or other functions important for the safety of persons or property, it must therefore be ensured that the shutdown

- is effected directly by positively driven contacts which shut down either the motor supply line or the power supply to the amplifier.

Caution

For further details see the relevant regulations, including DIN VDE 0113, EN 60204 “Safety of machines, electrical equipment in machines”.

Do not

Please note:

- The operating voltage must not be switched off and on on the DC side,
  - because the charging capacitor of the power supply would be switched directly onto the input capacitor of the amplifier,

– this would result in current peaks of more than 1000 A, which would destroy the relay contacts and overload the capacitors.

Tip

- Therefore, switch the operating voltage off and on before the power supply.

8 Commissioning

Tip

For the initial commissioning proceed as described below. Deviate from this procedure only when you have gained enough experience with the devices.

8.1 Precautions

Danger

Power off
wait > 2 min

For commissioning, you must always

- disengage the motor from the machine part to be driven, so that its operation can be observed without endangering the machine,
- switch off the mains voltage when carrying out connections and disconnections or replacing components in the amplifier or when working on the motor.

If you wish to proceed particularly cautiously because a high risk can be expected with a particular machine in the event of operating error,

- you should allow a small current only and thus a low torque:
  - Make a note of the actual setting of the rotary switch for current limiting (see section 5.2, page 47).
  - Set the rotary switch to a low value (near the “0” position).
  - After commissioning, restore the original setting of the rotary switch.

8.2 Switching on for the first time

Check

Before switching on, carefully check

- to see whether all connections have been correctly established,
- to ensure that the controller enable input does not block the controller,
- to ensure that the limit switches are closed if the Z1 or Z4 add-on module is being used.

Supply the setpoint using a potentiometer. You can do this as shown in fig. 8 using the auxiliary voltage outputs (section 4.2.1, page 23). Recommended value: 5 to 10 kΩ.

If the supply voltage is now applied while the motor is connected,

- the green LED must light up,
- and the motor must rotate at a speed corresponding to the setpoint applied.

If this is not the case, please check the connection once more. Consult the fault chart in the appendix as well.

Pins of the connector X2, encoder signals (“Steuersignale”)

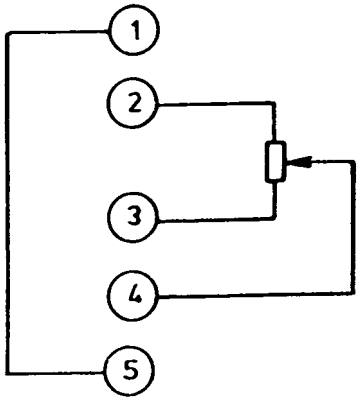


Fig. 8: Setpoint potentiometer connection for commissioning

8.3 Setting the speed

During commissioning, the speed is set with the trimmer “Speed” (“Drehzahl”) for the given setpoint.

The speed control range is factory-set for the used motor (if known), see type code (page 15), Kx option. To obtain good speed resolution, the lowest possible range for the application should be selected. For conversion on site see section 11.1.1, page 81.

8.4 Setting the feedback: normal case

How to proceed with a speed controller:

Caution

- for drives with limited paths (e.g. carriage drives) check the correct functioning of the limit switches,
- engage the motor with the load to be driven,
- disconnect the higher-level controller, apply the setpoint using the setpoint potentiometer. Be careful with drives with limited paths!
- Observe motor behavior at different speeds and at standstill,
  - if the feedback is set too hard, the motor runs loud and rough,
  - if it is set too soft, you can move the motor back and forwards a little by hand. This “soft” behavior can cause inaccuracies later when the drive is operated with a higher-level controller.

- Turn the feedback trimmer (“Verstärkung”) clockwise until the motor runs loud and rough, then turn back the trimmer approx. one turn.

8.5 Setting the feedback: critical applications

How to proceed with critical applications:

- check limit switch, connect motor to load as above,
- apply setpoint to amplifier input via a switch so that a setpoint jump can be generated,
- generate a setpoint jump,
- record the step reply at the “Speed monitor” output with a memory oscilloscope,
- evaluate the step reply and correct the feedback setting:
  - for most applications: the speed should reach its final value as fast as possible but only with a slight overshoot.

Under extreme conditions, the adjustment range of the feedback may be insufficient. In this case the reset time must be changed. For further details see section 11.2.1, page 85.

8.6 Setting the feedback with Z4 add-on module

Tip

For the purpose of commissioning, a special module is available on which

- potentiometers for the I time constant and limitation threshold are mounted.

The special module is not suitable for normal operation, because the potentiometers

- jut out of the amplifier and
- can only be adjusted when the device is open.

The locations of the solder bridges on the Z4 add-on module are indicated in section 11.3 (page 85ff).

How to proceed with a speed controller with I component limitation:

- check limit switch, connect motor to load as above,
- switch off I component (close t0 solder bridge),
- adjust P controller (turn the feedback trimmer (“Verstärkung”) clockwise until the motor runs loud and rough, then turn back the trimmer approx. one turn),

- set limitation threshold to 20% (close lim2 solder bridge),
- switch on I component (open t0 solder bridge),
- apply reversing motion by position control:
  - optimize step response by reducing the I time constant (t1 and t2 solder bridges),
- select limitation threshold:
  - disturbing overshoot: decrease limitation (lim1),
  - following error: increase limitation (lim3),

  optimize I time constant again if necessary.

8.7 Setting the current limit

Factory setting for delivery of drive packages (amplifier and motor):

- Current limit is set to the rated current of the motor.

For changing the current limit at the open device through the “Current” rotary switch see section 5.2, page 47.

Tip

It is essential that you should document the new switch position in the table in section 12, page 90, if you have changed the factory settings.

Caution

Never set the continuous current higher than permissible for the motor. Otherwise may damage the motor. Should the motor require a higher current in order to work properly, then it has not been dimensioned adequately and a more powerful motor must be selected.

8.8 Setting the offset

Set the offset only when the device has reached operating temperature. How to proceed:

- make setpoint zero; the best way is to disconnect the setpoint cable from the source directly at the setpoint source and short-circuit it,
- observe motor shaft,
- or observe pulse output if an encoder module is fitted,
- set offset trimmer so that the motor comes to a standstill as well as possible.

8.9 Setting the holding control loop amplification

Applicable only if the F1 function module “Hold function” for the holding control loop is fitted. How to proceed:

- set the “Hold” trim potentiometer in accordance with the application. Excessive amplification leads to unevenness or vibrations in the drive.

To adjust the “Hold” trim potentiometer

- remove the mains voltage;

Do not

  – The servo amplifier must not be operated when it is open.

- pull the servo amplifier out of the chassis for about 40 mm. The trim potentiometer on the customer module is now accessible.

Chapter 3: Power supply and accessories

9 Power supply of the servo amplifiers

9.1 Load factor

The load factor gives the number of amplifiers that can be connected. You will find it in the technical specifications for the amplifiers, the power supplies and the mains transformers. The following applies:

- When all amplifiers are being operated simultaneously at full load, the sum of their load factors must not exceed the load factor of the power supply and the one of the mains transformer.
- When not all amplifiers are being operated simultaneously at full load, (which is frequently the case with servo drives), the total load factor is the sum of the load factors of the amplifiers being operated simultaneously.
- When amplifiers are operated under part load only, their load factors are reduced for purposes of the calculation in proportion to the part load.

Example:

- The KSV 6/20 KSV 6HE amplifier has a load factor of 16, the 2800140000 power supply has a load factor of 75; this means that this power supply can run 4 of these amplifiers simultaneously at full load and still has plenty of reserve. For 4 of these amplifiers the transformer 038100130Z with a load factor of 80 has to be used as mains transformer.

9.2 Power supply

The servo amplifiers, the power supply, and the mains transformers are well matched.

9.2.1 Design

Design of the power supply (order number 2800140000):

- 19" plug-in module, designed in the same way as the servo amplifier, for installation into the 19" chassis together with servo amplifiers.

The power supply contains

- the mains rectifier,

- the charging capacitors,
- the monitoring circuit, and
- the shunt regulator with a shunt resistor sufficient for common servo applications.

For the plug-in power supply, various mains transformers are available.

9.2.2 Shunt regulator

During braking, the kinetic energy of a rotating servo motor is fed back into the power supply as electrical energy,

- this causes the bus voltage to rise.

A shunt regulator (also called shunt circuit) built into the power supply

- prevents that the power transistors are destroyed by that.

For higher shunt performance, an external shunt resistor can be used. For further details see section 9.2.6 (page 71).

9.2.3 Connection assignment (terminal blocks X5 and X6)

28 terminals in 5 blocks are located on the front panel of the power supply.

- Upper block: connection for the external shunt resistor,
- second block: 7 terminals connected in parallel for the positive pole of the bus voltage, labeled $+U_B$,
- third block: 7 terminals connected in parallel for the negative pole of the bus voltage, labeled $-U_B$,
- fourth block: 7 terminals connected in parallel for the PE connection of the amplifiers,
- lower terminal block with larger terminals: connection of mains transformer.

Terminal assignment:

Marking	Assignment
Terminal block X5:	
R_{ext}	Either connect external shunt resistor between R_{ext} and $+R_B$ or install jumper from R_{int} to $+R_B$. Jumper is factory-set.
R_{int}	
$+R_B$	
$+U_B$	7 terminals connected in parallel for positive pole of bus voltage. This allows a separate line to be laid to each of 7 connected amplifiers.
:	
$+U_B$	
$–U_B$	7 terminals connected in parallel for negative pole of bus voltage. This allows a separate line to be laid to each of 7 connected amplifiers.
:	
$–U_B$	
PE	7 terminals connected in parallel for PE. This allows a separate line to be laid to each of 7 connected amplifiers.
:	
PE	
Terminal block X6:	
PE	Power safety ground
U	Phase 1 secondary side transformer
V	Phase 2 secondary side transformer
W	Phase 3 secondary side transformer

For details on the laying of cables, see fig. 6 and section 4.4.4, page 40.

Please note that the terminals are in reverse order compared with the connections on the amplifier.

Check

There are three fuses for the operating voltage on the board. For dimensions and value of the fuse links see section 9.2.5, “Technical specifications of the power supply”.

9.2.4 LEDs

The three LEDs have the following meanings:

Check

Marking	Color	Display
Fault “Störung”	red	• lights up when input voltage is too low • lights up when power supply is overheated • lights up when fuse is defective • lights up when shunt circuit is short-circuited
Ready “Bereit”	green	• lights up when output voltage >160 V and there is no fault
Shunt “Ballast”	yellow	• lights up when the shunt circuit for accepting the energy returned when the motor is braked is switched on

9.2.5 Technical specifications of the power supply

Power supply	2800140000
Mains connection via isolating transformer	3 × 230 V AC +10%
Minimum mains voltage	3 × 120 V AC
Nominal bus voltage	320 V DC
Min. bus voltage	160 V DC
Response threshold of shunt regulator	380 V DC
Load factor	75
Maximum continuous braking power	100 W
Peak braking power, 2% switching cycle, 2 sec.	1200 W
Fuse-link mains input (6 × 32 mm)	3 × 20 A T
Fuse-link shunt circuit (6 × 32 mm)	3.15 A T
Climatic category (DIN EN 50178) operation / storage / transport	3K3 / 1K4 / 2K3
Dimensions: Width Height Depth (without connector)	 14 units / 71 mm 6 height units / 262 mm 195 mm
Weight	1.8 kg

9.2.6 External shunt resistor

Operating the unit as a braking controller, where the motors mainly have to work against an external torque in braking mode, requires an external shunt resistor dimensioned for the required power. The internal resistor is insufficient for this.

The resistance of the external shunt resistor should lie between 27 Ω and 33 Ω. The load capability has to be dimensioned according to the required braking power.

If you would like to use an external shunt resistor instead of the internal one, then

- remove the jumper between R_{int} and $+R_B$,
- connect the external resistor to the connections R_{ext} and $+R_B$.

The external shunt resistor

- must be installed in an earthed metal housing
  - to avoid emission and
  - as a protection against contact with live parts and with the hot resistor.

CE/EMC

The cable

- must have a cross-section of 1.5 mm^2 and
- must be shielded.

CE/EMC

Note the connection directions, section 4.4.7 “Shield connection of the external shunt resistor cable”.

The output for the shunt resistor is short-circuit proof. In case of a short-circuit

- the shunt circuit will be switched off.
  - The red LED indicates the fault.

As a consequence, the bus voltage increases during braking until the connected amplifiers switch off due to overvoltage,

- the red LED of the amplifiers indicates the fault,
  - the “Fault” (“Störung”) output switches on.

This fault can only be reset

- by switching the mains voltage off and on again.

9.3 Mains transformers

9.3.1 General information

The mains transformers are laid out for three-phase connection.

As well as the standard transformers shown in the following table, we can also supply special versions, further details on request.

In accordance with the data given, the transformers can also be ordered by the user from a local manufacturer in order to save the comparatively high costs of post and packaging.

CE/EMC

The transformers have separate primary and secondary windings. Autotransformers are not permissible.

9.3.2 Connections

The connections are clearly labeled on the terminals of the transformers.

9.3.3 Technical specifications of the mains transformers

Transformer		038100050Z	038100070Z	038100090Z	038100130Z
Mains connection (primary)		3 × 400 V			
Output voltage		3 × 230 V			
Load factor (power supply dimensioning)		15	25	40	80
Rated output		1.2 kVA	2.5 kVA	3.5 kVA	7.5 kVA
Primary-side back-up fuses		3 × 4 A T	3 × 6 A T	3 × 10 A T	3 × 16 A T
Wiring	Recomm. cross-section	1.5 mm^2	1.5 mm^2	2.5 mm^2	4.0 mm^2
	Minimum cross-section	0.75 mm^2	1.0 mm^2	1.5 mm^2	2.5 mm^2
Necessary RFI-filter		002057020Z			002057040Z
Dimensions (L × W × H in mm)		200 × 123 × 175	240 × 155 × 205	260 × 150 × 225	340 × 194 × 284
Weight		19 kg	20 kg	44 kg	73 kg

The following applies for combinations of several amplifiers with one transformer:

- The load factors of the amplifiers working simultaneously on one power supply at full load are added, and the proportionally reduced load factors of the amplifiers working under part load are added. The total load factor thus calculated determines the transformer required.
- Check to make sure that the load factor of the power supply is not exceeded.
  - If it is exceeded, several power supplies and possibly several transformers must be used.

If more than one power supply is connected to one mains transformer

- the bus voltages (i. e. the outputs) of these power supplies must not be connected.

– If this cannot be ensured, a separate mains transformer has to be used for each power supply, or a common transformer with separate secondary windings.

CE/EMC

A RFI-filter has to be switched behind the secondary winding of the mains transformer and therefore before the power supply input, see sections 4.4.4 (page 40) and 10.2.7 (page 80).

10 Accessories

10.1 Available accessories and order numbers

Accessories	Order number
Chassis 84 units, empty, for up to 7 KSV 6HE servo amplifiers and 1 power supply, with fan units, for installation in 19" racks or in the control cabinet	089100010Z
Chassis 54 units, empty, for up to 4 KSV 6HE servo amplifiers and 1 power supply, with fan units, for installation in the control cabinet	089100020Z
Connector set for KSV 6HE servo amplifier without encoder module option	099066020Z
Connector set for KSV 6HE servo amplifier with encoder module option	099066010Z
Synchronization unit (see separate operating instructions)	086047010Z
Connector set for 2 KSV 6HE amplifiers and one synchronization unit	099070010Z
Motor connection cable, 4 cores, cross-section 1.5 mm^2, shield	535246...Z
Motor connection cable, 4 cores, cross-section 2.5 mm^2, shield	535264...Z
Resolver/Encoder connection cable, 8 cores, twisted pair, shield	535245...Z
Ferrite ring for interference suppression of supply cables	042103010
Motor choke with terminals and enclosure, for medium-length cables (up to 25 m)	038096010Z
Motor choke with terminals and enclosure, for longer cables (more than 25 m)	038097010Z
RFI-filter 16 A	002057020Z
RFI-filter 36 A	002057040Z
Shield connection plate	089159

10.2 Description of accessories

10.2.1 Chassis

All are 7 height units high (6 height units for the plug-in modules, 1 height unit for the fan unit),

- 84 units wide, in common 19" design, mounting flanges and handles at the front, for installation in 19" racks or on a mounting plate, order number 089100010Z,
- 54 unites wide for installation on mounting plate, mounting flanges at the rear, without handles, order number

The chassis 84 units wide can accommodate 7 amplifiers and 1 power supply. The chassis 54 units wide can accommodate 4 amplifiers and 1 power supply.

The chassis with fan units provide at the lower part of the front

- wiring duct to accommodate the DC bus connections between power supply and servo amplifiers.

At the same location, there is a 3-pin Combicon connector for supply of the fans.

- Supply 230 V mains voltage. Assignment (from left to right):

L	N	PE

10.2.2 Connector sets 099066020Z and 099066010Z

The amplifiers are supplied without mating connectors. The connector set comprises all necessary connectors:

- The connector set 099066020Z includes connectors for the version without encoder module (G0)
  - two SUB-D connectors with screwable housings and
  - one 7-pole Combicon female connector.
- The connector set 099066010Z for the version with one of the encoder module options (G1 to G4) includes
  - one additional SUB-D connector with screwable housing.

The housings of the connectors are metallized and therefore shielded.

10.2.3 Motor connection cables 535246...Z and 535264...Z

The motor must be connected with a shielded cable. Characteristics of our motor connection cable:

- 4-core, shielded,
- cross section 1.5 mm^2 in the case of 535246...Z,
- cross section 2.5 mm^2 in the case of 535264...Z,
- suitable as trailing cable.

Choose the appropriate cable according to the required cross sections given in table “Technical specifications” on page 16.

Technical specifications:

Motor connection cable	535246...Z	535264...Z
Cable code	KWLifPETPC11Y JZ 4 × 1.5 mm^2	KWLifPETPC11Y JZ 4 × 2.5 mm^2
Single core	1.5 mm^2 Cu litz bare, 192 × 0.1 mm	2.5 mm^2 Cu litz bare, 320 × 0.1 mm
Structure	4 cores stranded with optimized length of twist	
Color coding	1 × green/yellow PE cond., 3 × black Z1 – Z3	
Total shield	Cu braiding, tin-coated 0.1 mm single wire diameter	
Total sheath	Polyurethane orange RAL 2003	
Diameter	7.8 ± 0.3 mm	9.7 ± 0.3 mm
Bending radius for single bend, fixed installation	min. 65 mm	min. 80 mm
Rolling radius for continuous altern. bending, trailing use	min. 95 mm	min. 120 mm
Operating temperature	–50 to +90 °C (fixed installation) –30 to +80 °C (trailing use)	

10.2.4 Resolver/Encoder connection cable 535245...Z

The resolver/encoder connection cable is suitable for connecting the position sensor (resolver) as well as for connecting a positioning controller to the “sensor signals” output. Characteristics of our resolver/encoder connection cable 535245...Z:

- 8-core, shielded,
- twisted pair,
- suitable as trailing cable.

Technical specifications:

Res./Enc. connection cable	535245...Z
Cable code	KWLiFPETP(C)11YP OB 2 × 4 × 0.25 mm^2
Single core	0.25 mm^2 C -Litz bare, 19 × 0.127 mm
Structure	4 pairs stranded with short length of twist
Color coding	white/brown, green/yellow, grey/pink, blue/red
Total shield	Cu mixed braiding, tin-coated, coverage 85%
Total sheath	Polyurethane orange RAL 2003
Diameter	6.4 ± 0.3 mm
Bending radius for single bend, fixed installation	min. 80 mm
Rolling radius for continuous altern. bending, trailing use	min. 150 mm
Operating temperature	–40 bis +80 °C (fixed installation) –30 bis +70 °C (trailing use)

10.2.5 Ferrite ring 042103010

The ferrite ring damps the high frequency interference immediately at the terminal. For application see connection directions in section 4.4 on page 36ff.

Dimensions ferrite ring 042103010	
Outer diameter	16 mm
Inner diameter	8.5 .. 10 mm
Height	6.3 mm

10.2.6 Motor chokes 038096010Z and 038097010Z

CE/EMC

Check

Longer motor cables can overload the device and cause unacceptably high interference emission.

- For this reason, a motor choke must be fitted in the motor cable if the cable is longer than 7 m. For the correct choke please refer to the following table.

Both motor chokes are supplied in a steel plate housing ready for installation and connection. They are supplied with terminals and with cable clamps.

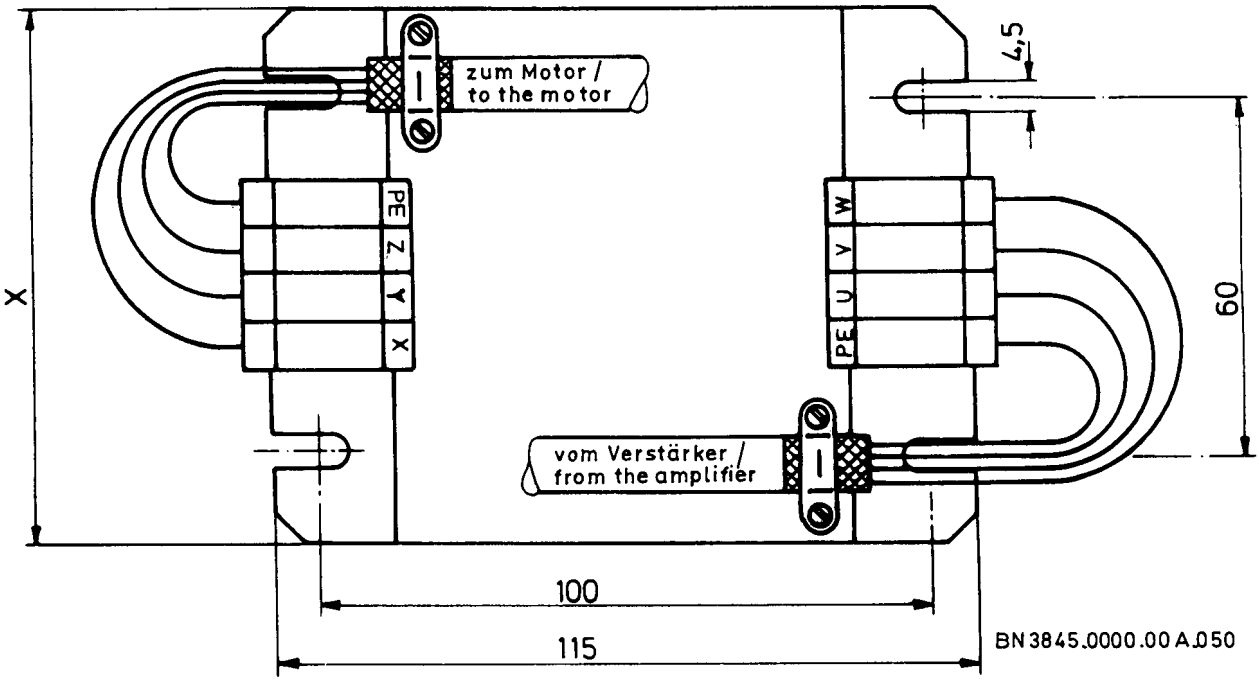
Figure 9 shows the mounting dimensions, the connection (please note the connection of the shield) and the marking of the terminals.

Caution

During operation under full load, the chokes can reach a temperature of over 100 °C. To ensure adequate heat dissipation, they must be screwed to a sufficiently large metal plate.

Technical specifications:

Motor choke	038096010Z	038097010Z
Permissible current	10 A	12 A
Inductance	3 × 0.8 mH	3 × 0.9 mH
For cable lengths when using KSV 6HE amplifiers	7 to 25 m	more than 25 m
Internal design	partially compensated triple choke	3 single chokes



Dimensions	Distance X	Housing height
038096010Z	90 mm	40 mm
038097010Z	130 mm	45 mm

Internal choke	Input	Output
1	U	X
2	V	Y
3	W	Z

Fig. 9: Motor chokes

10.2.7 RFI-filters 002057020Z and 002057040Z

As described in section 4.4.4, a RFI-filter has to be connected between the mains transformer and the power supply in any case. The precise installation instructions can be found there.

The filter has to be dimensioned

- according to the power of the power supply or the mains transformer, respectively.

You find the suitable filter

- in the table of the technical specifications of the mains transformers, page 73.

Figure 10 shows the dimensions of the RFI-filters.

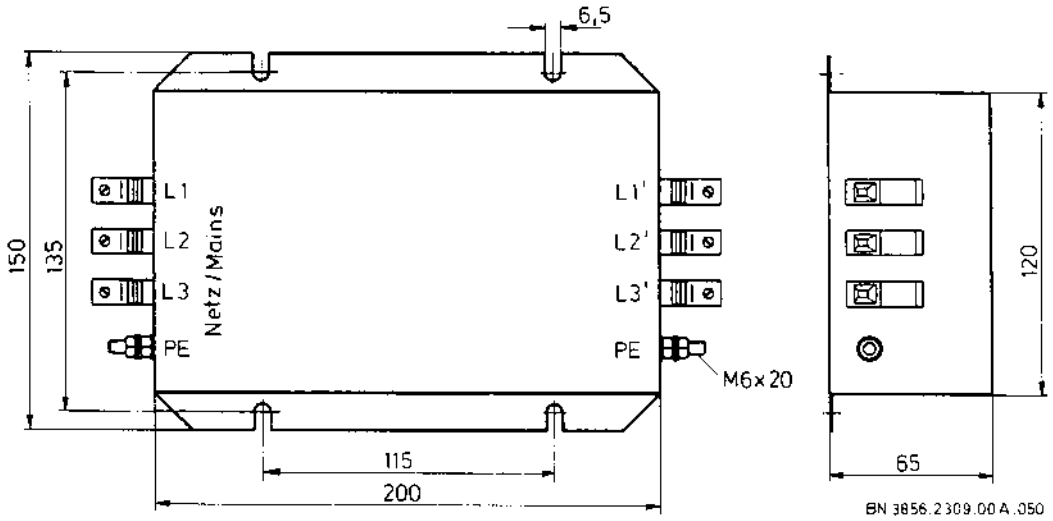


Fig. 10: RFI-filter

10.2.8 Shield connection plate 089159

CE/EMC

To establish earthing of the motor cable shield in compliance with EMC, the shields have to be connected close to the RFI-filter.

The shield connection plate 089159, which can be supplied as accessories, simplifies this procedure. It will be screwed together with the RFI-filter. 8 cable clamps are attached at the shield mounting side allowing the correct earthing of the shields of 6 motor cables and the shield of the connection between mains filter and power supply.

Chapter 4: Notes for specialists

11 Modifications to the servo amplifier

This section describes how the factory settings can be changed.

Tip

If you have changed the factory settings, it is essential that you should document the new settings in the table in section 12, page 90.

11.1 Modifying the controller circuitry

The controller circuit is defined by the name of the customer module, see type code, section 3.1, page 15. In some cases it is implemented on the customer module itself, in some cases through jumpers on the board. Electronics specialists can change the controller circuitry on site if required.

11.1.1 Speed control range

The speed control range is determined using the option K (K1, K2, K4, K5, KA, and KB). However, it is not implemented on the customer module, but by means of jumpers on the board. Modify by relocating the jumpers on the X 14 field, labeled “DREHZAHL” (= speed). 2 jumpers must always be placed at the same time. The positions are marked [1] and [2]. Figure 11 shows the location of the jumpers and the locating options.

The speed control range is factory-set for the used motor (if known), see type code (page 15), Kx option. To obtain good speed resolution, the lowest possible range for the application should be selected.

Relocating the jumpers changes the offset of the amplifier.

- If no add-on module is fitted, the offset can be reset using the offset trimmer on the front panel.
- If the amplifier is fitted with an add-on module, the offset must be readjusted in the manner described below. To do this, the offset trimmer on the front panel is required, as well as the potentiometer inside the device which is marked “n-OFFSET”. It is located at the very top behind the front panel, see fig. 11.

There are two options for offset adjustment:

- With measuring device:
  - Switch off the controller enable,

  - measure the voltage at the analog output “Speed monitor” and then make this voltage zero using the potentiometer “n-OFF-SET”.

- Without measuring device:
  - Make the setpoint zero;
  - before changing the jumpers adjust the offset with the trim potentiometer on the front panel so that the motor comes to a standstill as good as possible.
  - Switch off the mains,
  - only then change the jumpers,
  - switch on again.
  - Then adjust the offset again, but this time using the potentiometer “n-OFFSET” inside the device.

Note: If this adjustment is not carried out in this way when the Z module is in position, the tacho window could not be switched on when the motor is at a standstill, and therefore the amplifier would not be enabled at a standstill.

11.1.2 Number of motor pole pairs

The adaptation of the number of motor pole pairs is determined by the option K (K1, K2, K3, K4, K5, K6, KA, and KB). It is realized by jumpers on the board. Modify by relocating the jumpers on the field X 13.

There are 4 positions for each jumper. The positions are labeled 2PP, 4PP, Sel1 and Sel2. Figure 11 shows the location of the jumpers and the locating options.

- Jumper in position 2PP: motor with 2 pole pairs,
- no jumper plugged in: motor with 3 pole pairs,
- jumper in position 4PP: motor with 4 pole pairs,
- jumper in position Sel1 or Sel2: special motor, further details on request.

The number of pole pairs is factory-set for the used motor, see type code (page 15), Kx option.

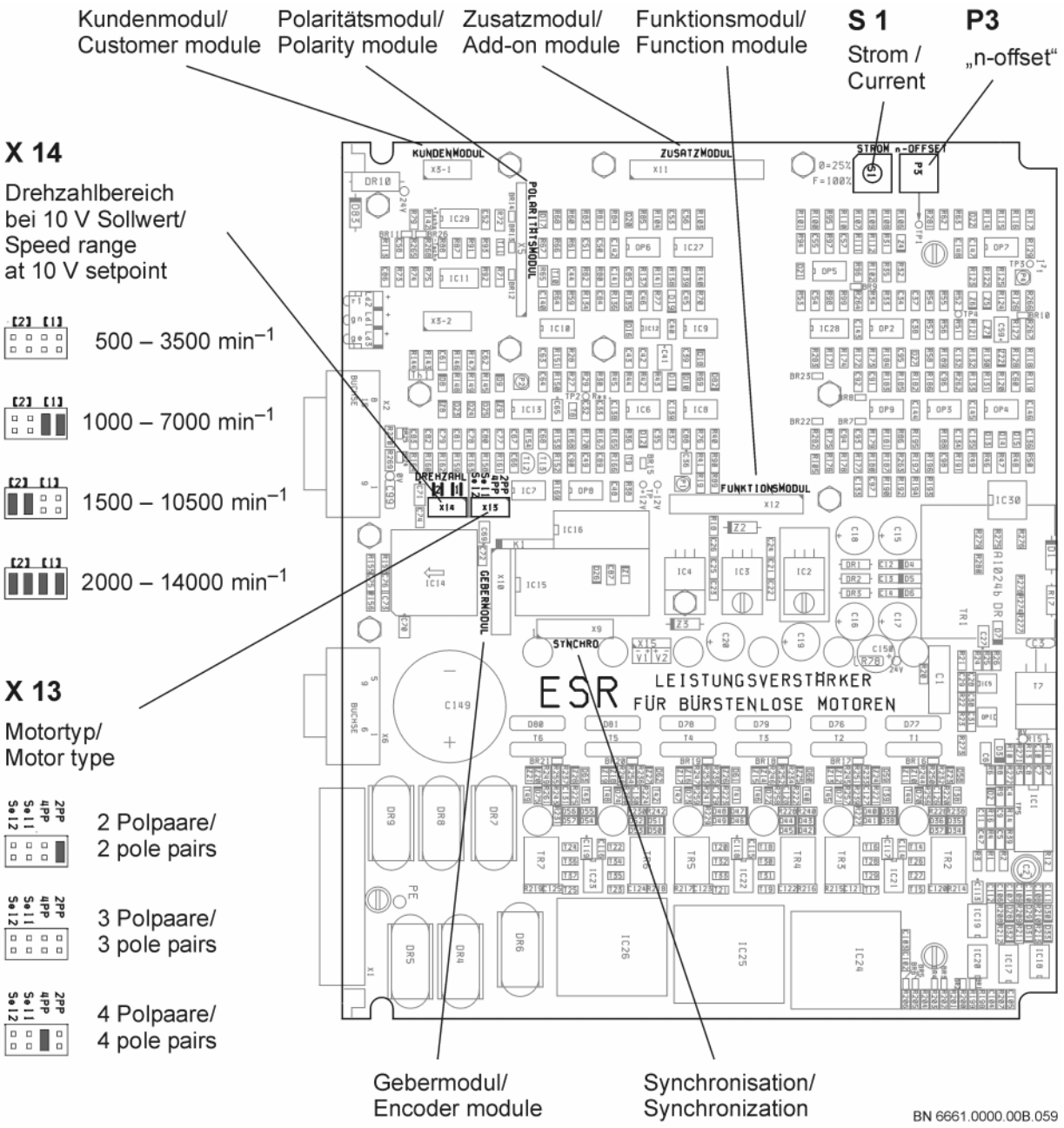


Fig. 11: Location of the jumpers on the board

11.1.3 Current control instead of speed control

Whether the servo amplifier is set for speed control or for current control is implemented on the customer module (module K3 for 2-pole-pair or K6 for 3-pole-pair motors).

To switch the servo amplifier from speed control (as supplied) to current control,

- insert a jumper in the “Moment” (=torque) position.
  - Figure 12 shows the location of the jumper.

The following then applies:

- 10 V setpoint corresponds to the peak current set at the “Current” rotary switch S1.

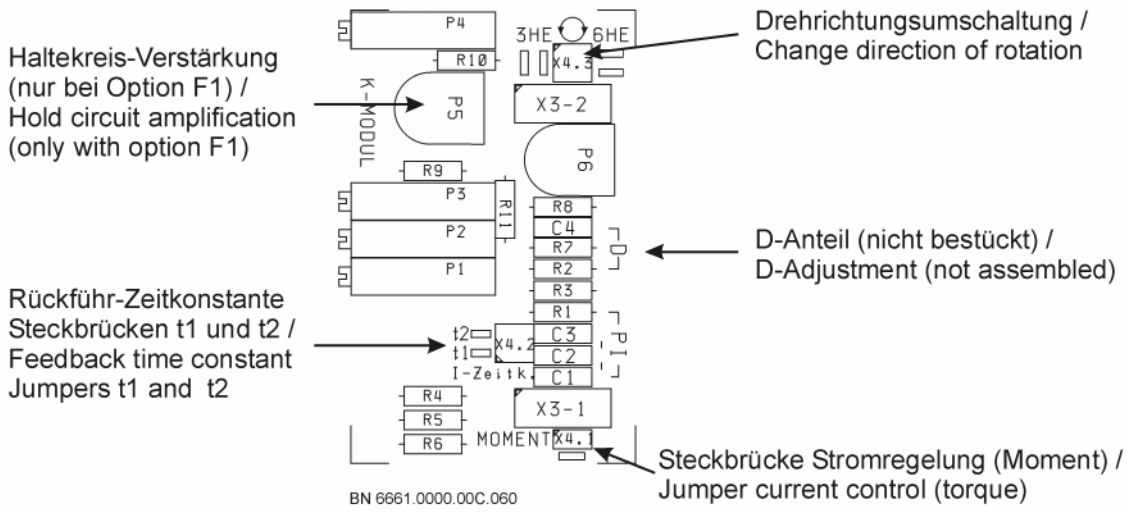


Fig. 12: Location of the jumpers on the customer module

Current control is not provided with the customer module belonging to the Z4 add-on module.

11.1.4 Changing the direction of rotation

The assignment of the direction of rotation to the polarity of the set-points is described in section 4.2.2 (page 23). If it is to be changed so that it corresponds to the direction of rotation assignment of the Georgii Kobold 3 units high servo amplifiers,

- then relocate the jumpers on the customer module from position “6 HE” to position “3 HE”.

11.2 Modifications to the feedback

As standard, the speed control is realized as PI-controller.

11.2.1 Reset time

The customer module has two additional capacitors with which the reset time of the speed controller can be increased. These capacitors can be connected to the existing capacitor by means of the jumpers t1 and t2.

Figure 12 shows the location of the jumpers. The following applies:

Solder bridge	Reset time
none *	3.3 ms
t1	6.6 ms
t2	10 ms
t1 + t2	14 ms

* standard factory setting

With the Z4 add-on module, the I time constant can be adjusted on the add-on module itself.

11.2.2 D circuit

If a D circuitry is to be connected to the speed feedback (PID controller), the components C 2 and R 10 must be installed on the customer module. Their locations are printed on the board (see fig. 12). The values must be determined by experiment. 100 nF and 100 kΩ can be regarded as guide values.

D circuitry connection is not provided with the customer module belonging to the Z4 add-on module.

11.3 Modifications to the Z1, Z2, and Z4 add-on modules

11.3.1 Location of the solder bridges

The following figures show the position of the solder bridges on the Z1, Z2, and Z4 add-on modules.

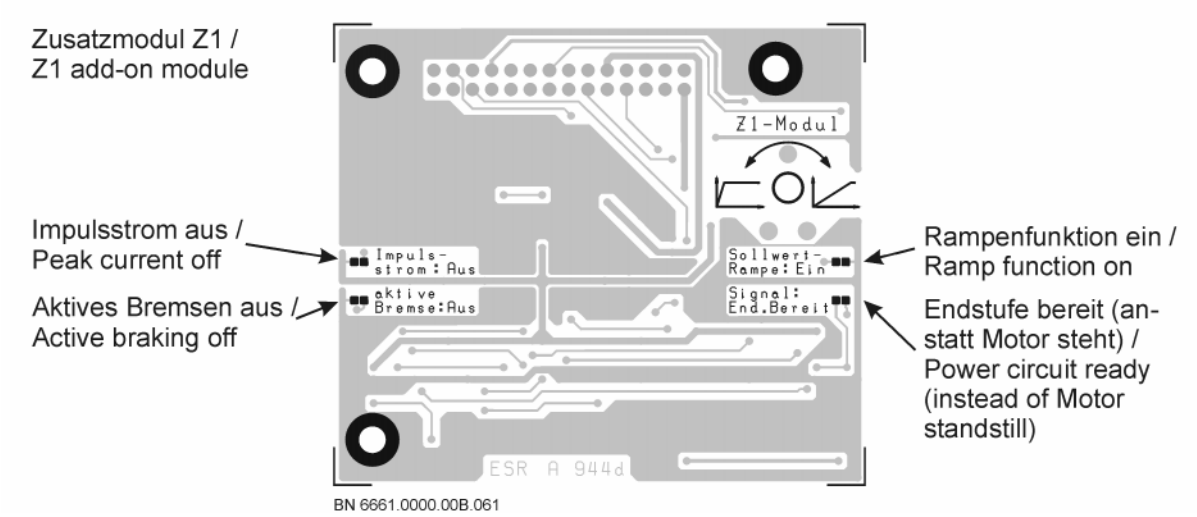


Fig. 13: Solder bridges on the Z1 module

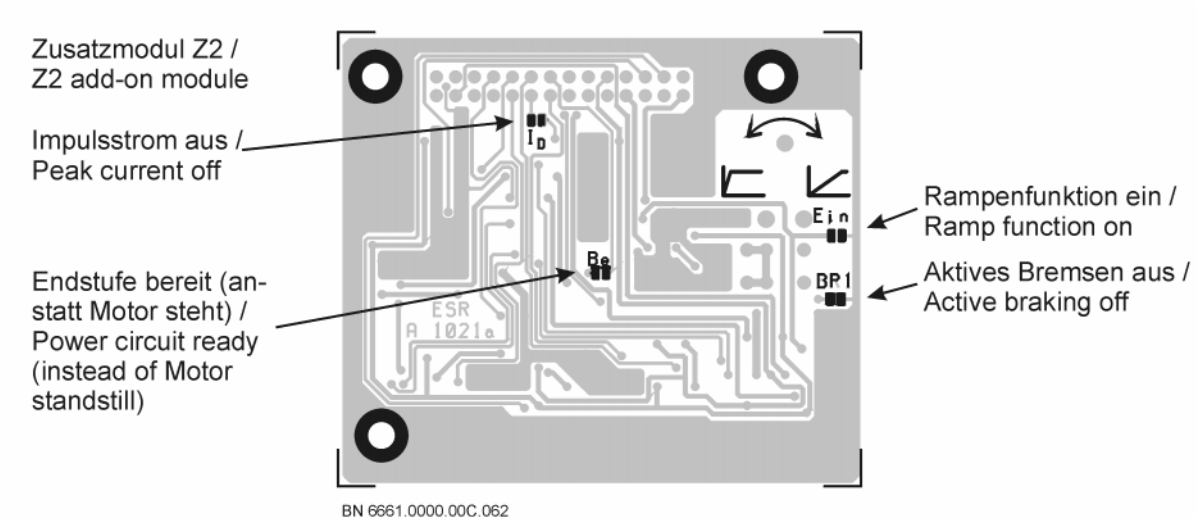


Fig. 14: Solder bridges on the Z2 module

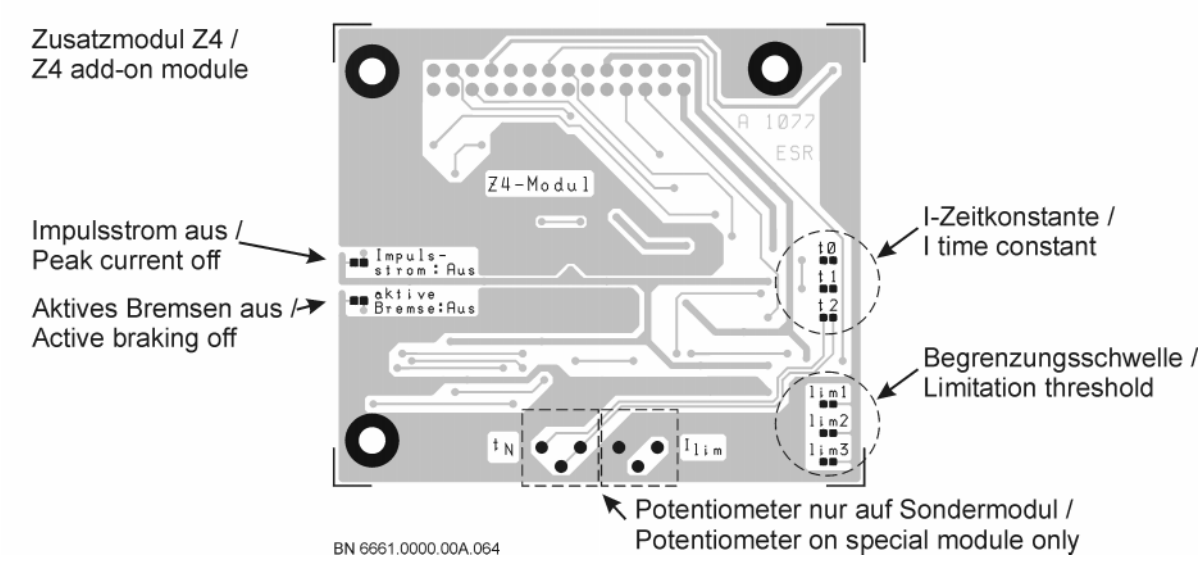


Fig. 15: Solder bridges on the Z4 module

11.3.2 Former versions of modules Z1 and Z2

Check

The following description of the Z1 and Z2 add-on modules applies to the devices delivered now. Former versions of the add-on modules have other jumpers or fewer functions. They have other layouts as the modules shown in fig. 13 and 14. If your amplifier is fitted with other modules, please contact us so that we can send you matching documentation.

11.3.3 “Power circuit ready” signal instead of “Motor standstill” signal

If one of the Z1 or Z2 add-on modules is fitted, the switching output provides the signal “Motor standstill” (factory setting).

Modify by setting a solder bridge on the add-on module,

- without solder bridge: “Motor standstill” signal,
- with solder bridge: “Power circuit ready” signal.

The position of the solder bridge is labeled (see fig. 13 or 14)

- “Signal: End. Bereit” on the Z1 module,
- “Be” on the Z2 module.

The Z4 add-on module provides the “Power circuit ready” signal.

11.3.4 Switching off the peak current rise

To switch off the peak current rise,

- set a solder bridge on the add-on module.

The position of the solder bridge is labeled (see fig. 13, 14, or 15)

- “Impulsstrom: Aus” on the Z1 and Z4 modules,
- “I_D” on the Z2 module.

11.3.5 Switching off active braking at controller disable

If the motor should not be braked actively by reverse current when controller enable is suspended (that is, at controller disable),

- set a solder bridge on the add-on module.

The position of the solder bridge is labeled (see fig. 13, 14, or 15)

- “aktive Bremse: Aus” on the Z1 and Z4 modules,
- “BR1” on the Z2 module.

11.3.6 Activating the ramp function

The ramp function is disabled as delivered. It is activated

- by setting a solder bridge on the add-on module.

The position of the solder bridge is labeled (see fig. 13 or 14)

- “Sollwert-Rampe: Ein” on the Z1 module,
- “Ein” on the Z2 module.

The Z4 add-on module has no ramp function.

11.3.7 Adjusting and limiting the I component of the speed controller

Using the t0, t1, and t2 solder bridges, the I time constant of the speed controller I component can be adjusted on the Z4 add-on module.

Figure 15 shows the location of the solder bridges. The following applies:

Solder bridge	I time constant
t0	no I component
none	25 ms
t1	2.5 ms
t2	1.25 ms
t1 + t2	0.8 ms
Potentiometer *	1.25 .. 25 ms

* only on special module for commissioning aid

Using the lim1 to lim3 solder bridges, the I component can be limited on the Z4 add-on module. The limitation threshold is given in percent of the maximum permissible pulse current. The following applies:

Solder bridge	Limitation threshold
none	100%
lim1	10%
lim2	20%
lim3	30%
Potentiometer *	0 .. 55%

* only on special module for commissioning aid

11.4 Modifications to the polarity module

11.4.1 “Ready” signal instead of “Fault” signal

The P1 polarity module supplies, among other things, the “Fault” signal, while the P2 polarity module supplies the “Ready” signal.

To convert from P1 to P2

- connect the two soldering areas labeled “Be” on the polarity module, see fig. 16.

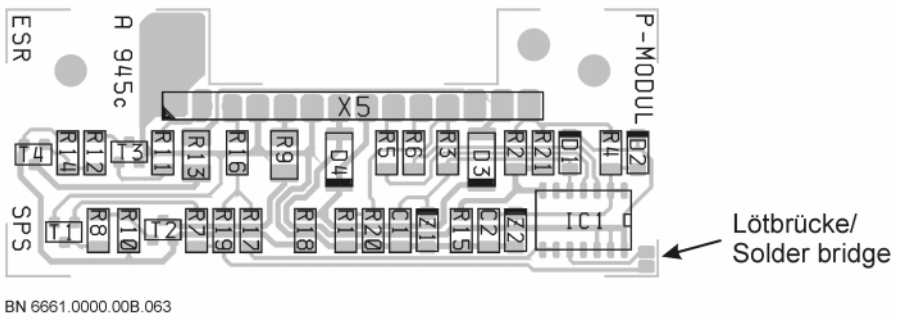


Fig. 16: Solder bridges on the P1 and P2 modules

12 Documentation of the settings

Tip

Copy this page and enter into the following tables the nameplate information and all of the settings and modifications you have carried out. Keep these sheets with your documentation. If you should later require a similarly configured or modified device, send us a copy of these tables.

Nameplate information::

In case of multiple devices: Device No.	
	SN

Current setting, the switch setting is marked with a cross:

0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

Encoder pulse setting, the switch setting is marked with a cross:

0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

Speed control range, the range set is marked with a cross:

3,500 min^{-1} (open)	7,000 min^{-1} ([1])	10,500 min^{-1} ([2])	14,000 min^{-1} ([1]+[2])

No. of pole pairs, set number of pole pairs is marked with a cross:

2 pole pairs (2PP)	3 pole pairs (open)	4 pole pairs (4PP)

Current control instead of speed control, marked with a cross if jumper is set:

Jumper in position “torque” (“Moment”)

Standard direction of rotation, set direction of rotation is marked with a cross:

3 HE	6 HE

Reset time, the set time constant is marked with a cross:

3.3 ms (open)	6.6 ms (t1)	10 ms (t2)	14 ms (t1+t2)

Modifications to Z1 / Z2 add-on module, closed solder bridges marked with a cross:

Power circuit ready (“Signal: End. Bereit” / “Be”)	Peak current off (“Impulsstrom: Aus” / “I_D”)
Active braking off (“aktive Bremse: Aus” / “BR1”)	Ramp function on (“Sollwer-Rrampe: Ein” / “Ein”)

Modifications to Z4 add-on module:

Feedback time constant, the set time constant is marked with a cross:

– (t0)	25 ms (open)	2.5 ms (t1)	1.25 ms (t2)	0.8 ms (t1+t2)

Limitation of the speed controller I component, the set limitation is marked with a cross:

100% (open)	10% (lim1)	20% (lim2)	30% (lim3)

Modification to polarity module, marked with a cross when solder bridge closed:

Ready

Appendix

Appendix A EC Declaration of Conformity

GEORGII KOBOLD
AUGUST HEINE GmbH & Co
Total Quality

Form
Certificate of Conformity

Certificate of Conformity
in the sense of EC-Directive

Here with we confirm that the products

Product	GEORGII KOBOLD
Type	KSV 6HE, front connection
Series	KSV Servo Amplifier

correspond to the EC directives, standards and regulations below and are designed for installation in a machine. According to EC directive "Machines", commissioning is prohibited until it has been ascertained that the machine in which the above product is installed meets the provisions of the EC directive.

The requirements of the EC directives, standards and regulations will only be met if the directions for installation and cabling given in the operating instructions are observed.

Operating instructions 22 10 52E

The products are developed, constructed and produced in accordance to EC-Directive:
EMC-directive 89/336/EWG, amended by 91/263/EWG, 92/31/EWG, 93/68/EWG
Low voltage directive 73/23 EWG, amended by 93/68/EWG
of exclusive responsibility of

company **GEORGII KOBOLD** **AUGUST HEINE GmbH & Co**
Postfach 10 01 54 · D - 70745 Leinfelden-Echterdingen
Fasanenweg 6 - 8 · D - 70771 Leinfelden-Echterdingen
Telefon 0711 / 7 59 03 - 0 · Fax 0711 / 7 59 03 53

The signers are: Schilhab - head of quality department
Schramm - technical director

The following harmonised Standards are used:

- [X] EN 55011: 1991, class A and B (DIN VDE 0875, part 11)
- [X] DIN EN 50082-1: 1994
- [X] DIN EN 50082-2: 1995
- [X] DIN (pr) EN 50178: 1994
- [ ]

A technical documentation is completely available.

An operation instruction is available.

- [X] in the original version
- [ ] in the native language of the user.....

Dok.-Nr.:	Ausgabestand	erstellt / geändert: Schilhab	freigegeben / geprüft von: Schramm	Seite
10.4.31.	4	Datum / Signum 18. Januar 2000	Datum / Signum 18. Januar 2000	1 von 1

Appendix B Terms of warranty

warrants that the device is free of material and production defects. In quality assurance, measured values are recorded in the final inspection and testing.

The warranty period begins with delivery. It lasts for 12 months.

Delivery is based on the “General Terms of Delivery for Products and Services of the Electrical Industry” (green terms of ZVEI, German electrical and electronic manufacturers' association). In the event of a defect, or in case of absence of a guaranteed property, the device is to be returned. It is repaired in the works of the manufacturer free of charge, or replaced, at our discretion.

No other claims for damage which has not occurred in our device can be accepted. No claims for indirect damage resulting from a malfunction of or defect in our device may be put forward.

Appendix C Table of faults

If the drive does not work as desired, the following table of faults can help you to detect and eliminate the cause of the fault.

Observation	Possible Cause	Remedy
No LED lights up	No operating voltage for amplifier	Check input voltage
Green “Ready” LED flashes	Controller enable or limit switch open	Check cables, connections, limit switches
Red “Fault” LED lights up and green “Ready” LED flashes	No supply voltage (this display only in case of option E1)	Switch on operating voltage, check emergency stop circuit
	Operating voltage too low	Measure operating voltage, must be >160 V
	With option E1 only: External control circuit supply voltage too low, or has dips from poorly filtered rectification	Measure voltage, must be >19 V, check for dips below 19 V
	Faulty auxiliary voltage	Measure auxiliary voltage at connector for control signals (+15 V and –15 V, ±10%)
	Short circuit or earth fault in motor cables or in motor	Check wiring and motor for short circuit and earth fault
	Customer module missing or incorrectly inserted	Customer module forgotten or incorrectly inserted after amplifier replacement
	Blocking protection device triggered	Electrical fault: motor or resolver cables transposed, Mechanical fault: mechanism jammed or faulty
	Operating voltage increases excessively due to fault in shunt circuit	Check shunt circuit: shunt resistor missing or defective, many axes braking at the same time

Observation	Possible Cause	Remedy
Red and green LEDs flash alternately (when device is cold or at operating temperature)	Sensor not connected, one or more leads interrupted, one or more leads short-circuited	Check sensor wiring. This fault can be reset only by switching the operating voltage off and on again (with E1 of the external 24 V supply).
Red and green LEDs flash alternately after some period of operation. After some time the display changes to the following condition (see next row)	Amplifier has switched off due to overtemperature of its heat sink (or due to motor overheating)	Amplifier (or motor) cooling inadequate, temperature sensor has not yet switched back, fault reset not possible now
	Current limit set too high	Set to the current given for the motor
Red LED lights up continuously, green LED flashes		Amplifier (motor) has cooled down, temperature sensor has switched back, fault can now be reset
Yellow “Overload” LED lights up	Motor is overloaded or blocked	Check mechanical system
	Current limit set too low	Compare nominal motor data with setting
	Motor is not connected or a motor lead is interrupted	Check motor wiring
Motor is at a standstill with power, drifts slowly but cannot be controlled	Setpoint missing, setpoint lead interrupted or short-circuited	Check setpoint lead
Motor runs slowly at setpoint zero	Offset adjustment incorrect	Adjust offset potentiometer
Disturbing noise when motor is running(humming, whistling, chirping)	One setpoint lead is open, shield is not correct, motor is not earthed, transformer neutral point is not earthed	Check setpoint lead: It must be connected on one side to setpoint source zero volts. Check shield, check zero connection
Motor runs in the wrong direction	Setpoint inputs transposed	Transpose E+ and E– or set jumper on customer module
Motor runs too slowly or too fast at given setpoint	Speed standardization incorrect	Set to desired speed using “Speed” potentiometer, adjust speed control range if necessary (section 11.1.1)
Motor runs “rough” or “soft” after speed adjustment at speed potentiometer	Speed adjustment also influences feedback setting	Adjust feedback
Motor runs roughly or vibrates	Feedback too “hard”	Turn “Feedback” potentiometer to the left until motor runs smoothly
Motor shaft can be moved out of position by hand at standstill	Feedback too “soft”	Turn “Feedback” potentiometer to the right until motor runs roughly (vibrates), then to the left until motor runs smoothly
Motor begins to turn slowly at setpoint zero with increasing load	Zero loop, e.g. between amplifier zero and control zero	Use differential input, see section 4.4.9, page 44

Supplement for KSV 6HE with F1 option “Holding control loop”

Observation	Possible cause	Remedy
Motor is at a standstill with power, without drift, cannot be regulated	Holding control loop accidentally activated	Check “Hold” signal connection
Motor shaft can be moved by hand at standstill	If holding control loop is activated: Holding control loop too “soft”	Adjust “Hold” potentiometer

End of Operating Instructions 221052E